EDITORIAL

AS a result of technical investigation, the Federal Government recently announced that it had allocated 13 channels in the VHF band for television services.

The announcement was followed in short order by a spate of alarmist rumours. The following are samples:

(1) Existing stations are to be shifted to new frequency channels; this will necessitate alteration and adjustment to tuners.
(2) All existing 12-channel tuners will have to be rebuilt to include 13 channels.
(3) The crowding in of more stations will necessitate alterations and adjustments to all receivers at present in service to make them more selective.

In actual fact, these rumours could hardly be less accurate. The Postmaster General specifically stated that no changes would be necessary to the frequency of existing stations. The channel numbers may have to be changed—and this could cause some confusion—but the stations will continue to be received at exactly the same knob settings as now.

It will neither be practical nor necessary to convert 12-channel to 13-channel tuners. Twelve positions will be more than adequate for any given district for the foreseeable future. The main requirement will be that receivers, going into new service areas, be adjusted to receive the channels relevant in those areas.

There is no intention, that I know of, to modify significantly the bandwidth standards of either transmitters or receivers.

At the same time, I expect that the appearance of new transmitters will discover a few real problems, particularly in secondary service areas.

It seems inevitable, for example, that signals on the two lower frequency channels will be ducted across the continent at quite spectacular strength, at times, during summer months. Some interference will result.

In fringe areas, reception of distant city stations may be complicated by the appearance of powerful local transmitters on other channels.

And I'd be very surprised if new signals don't discover weaknesses in the adjustment of existing receivers, in those areas, which have thus far passed unnoticed. How careful, for example, have manufacturers been to date about the passband shape on the seven unused channels?

Inevitably, problems like these will accompany the expansion of television services, but I don't imagine that anyone is going to lose much sleep about them. Above all, there's not the slightest justification for these rumours which would have you believe that your television set is shortly to become obsolete.

N. Williams

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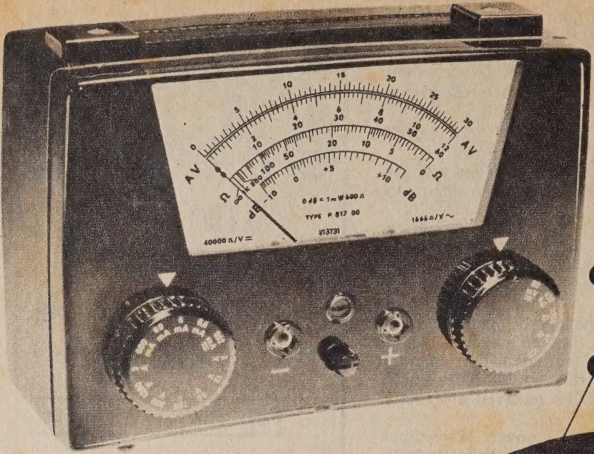
OUR COVER PICTURE

Despite their rather ungainly shape and appearance, helicopters are undergoing continuous and progressive development. This Boeing-Vertol 107 is claimed to be the fastest, smoothest and most versatile to date. See also page 17.



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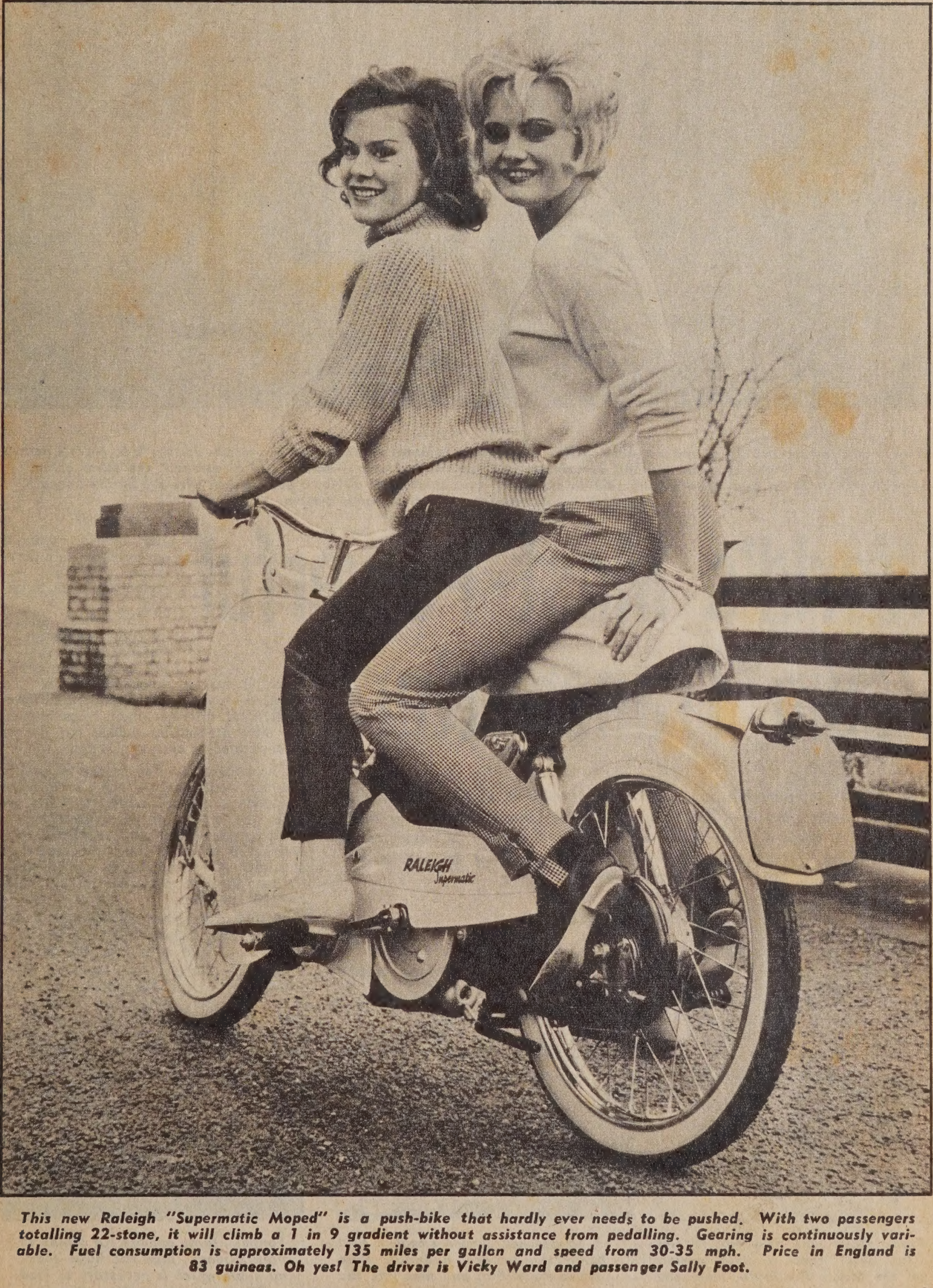
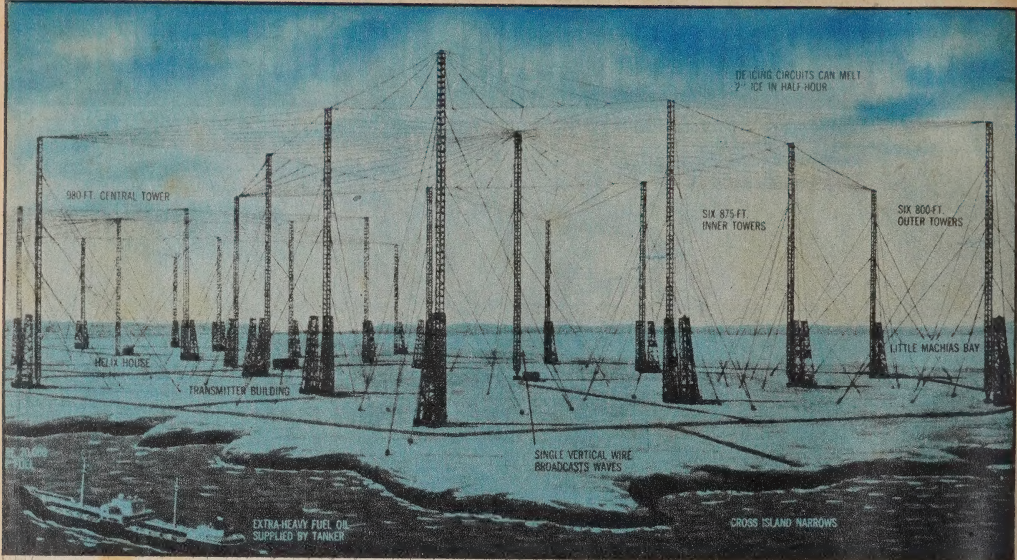
NEW BRITISH (NON) PUSH-BIKE



This new Raleigh "Supermatic Moped" is a push-bike that hardly ever needs to be pushed. With two passengers totalling 22-stone, it will climb a 1 in 9 gradient without assistance from pedalling. Gearing is continuously variable. Fuel consumption is approximately 135 miles per gallon and speed from 30-35 mph. Price in England is 83 guineas. Oh yes! The driver is Vicky Ward and passenger Sally Foot.


DE-ICING CIRCUITS CAN MELT
2" ICE IN HALF-HOUR
980 FT. CENTRAL TOWER
SIX 875 FT.
INNER TOWERS
SIX 800 FT.
OUTER TOWERS
LITTLE MACHIAS BAY
HELIX HOUSE
TRANSMITTER BUILDING
SINGLE VERTICAL WIRE
BROADCASTS WAVES
EXTRA-HEAVY FUEL OIL
SUPPLIED BY TANKER
CROSS ISLAND NARROWS

Twenty-six towers, not all of them visible in this illustration, support two huge aerial systems for the U.S. Navy's new super-power low frequency radio station. The enormous "top hat" of wires—one in the foreground, the other behind—each stretch more than a mile from side to side. Two thousand miles of No. 6 bare copper wire are buried beneath the ground to provide an effective earth system.

World's Most Powerful Radio Transmitter

A fantastic spider web covers an entire peninsula at the easternmost tip of Maine, U.S.A.—750 acres of bronze lace 800 feet and more above the ground. This is the antenna for the most powerful radio transmitting station ever built. Its purpose—to talk to submarines under water.

By Martin Mann

FROM that lonely finger of land, radio signals of unprecedented strength can reach every corner of the earth. They fit the final piece into the surest weapon in the U.S. Navy's arsenal (in any arsenal, the Navy claims). The weapon is a complex:

- The H-Bomb.
- Delivered by the Polaris missile—medium range, solid-fuelled.
- Fired from beneath the sea by an atomic-engined submarine.

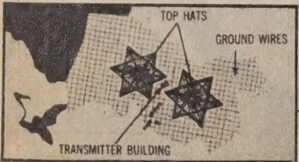
A-subs can cruise many months submerged. (Recently one went clear around the world without surfacing.) Underwater they are extremely difficult to detect.

The whole system is an unparalleled defence of retaliation — mobile, invisible. It could not be knocked out by unwarned attack, as might land-based intercontinental missiles—their huge launching sites are sitting ducks, too big to be concealed or even kept secret.

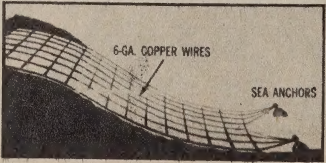
The trigger for this potent weapon is the new radio station NAA. Only its tremendous power (2,000,000 watts, 40 times the output of the biggest broadcasting transmitter) and unusually long waves (20 or more times the length of standard AM broadcasts) can dit-dah-dit-dah through seawater to the submerged sub fleet.

Should Doomsday come, only it can tell our quiet pickets under the sea, "Go there . . . and press the button."

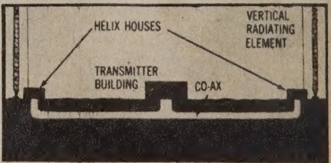
Ordinary radio signals cannot penetrate water. Until NAA goes on the air early this year, submarines must raise their antennas above the ocean surface to receive messages. Surfaced, even by so little, they are vulnerable. Radar or


TOP HATS
GROUND WIRES
TRANSMITTER BUILDING

From above, the two star-shaped "top hats" cover a large section on the Maine Peninsula. Note the extent of the earthing system.


6-GA. COPPER WIRES
SEA ANCHORS

A copper net, buried about a foot below the surface, underlies most of the Peninsula, and runs into the sea on three sides. Note anchors.


HELIX HOUSES
VERTICAL
RADIATING
ELEMENT
TRANSMITTER
BUILDING
CO-AX

Tunnels, large enough for a man to walk through, hold the huge coaxial cable which is necessary to feed RF from transmitter aerials.

just a sharp-eyed lookout can spot them, and the key advantage of the Polaris-armed A-sub is lost.

From the road, you can tell that this radio station is something special. It lies right beside route 191, a few miles off the tourists' U.S. 1.

Across Little Machias Bay, you see the whole peninsula, 2,850 acres stripped of scraggy pines and bulldozed level to sprout 26 sky-piercing towers, straight as giant pencils. Two climb 980 feet. That's nearly twice the height of the Washington Monument.

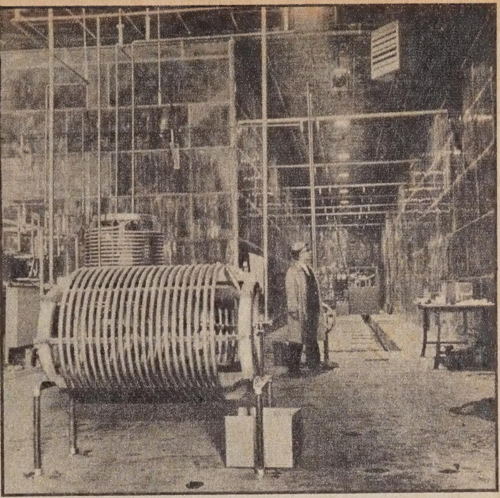
The great steel spires support two complex antennas that work together or separately. In each "array," the antenna proper (the part that sends out radio waves) is a single cable running straight up from the ground. To work best, it should stretch up at least one-fourth the length of the waves it transmits. That would come to five miles.

LOADED TOWERS

No towers go that high. So a shorter antenna element (about 900 feet) is fooled electrically into acting as though it reached the correct quarter-wavelength. This is the job of the vast web of cables draped over the towers.

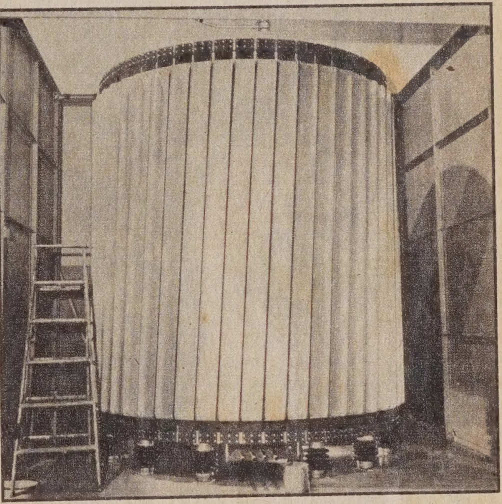
This "top hat" stretches more than a mile from side to side; you could nestle 11 Pentagon buildings underneath. It is fastened only to the centre tower. The edge cables run free over pulleys to gigantic counter-weights—220-ton wheels that ride on roller-coaster tracks. In a high wind (172 m.p.h. is bearable), the swinging cables will jig those cement-packed wheels 200 feet up and down.

The top-hat web is not the antenna proper—it does not broadcast radio waves—but serves as one plate of the biggest electrical capacitor ever made.

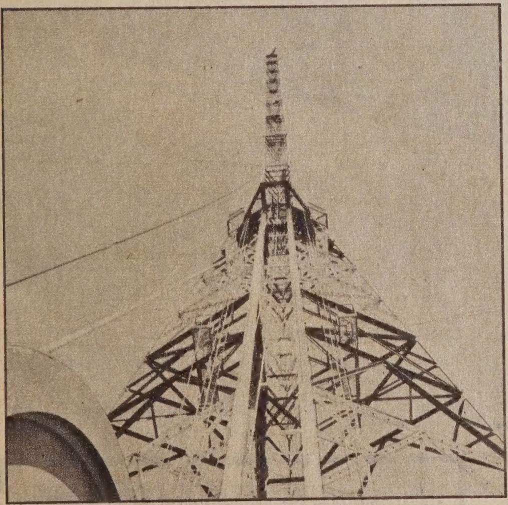


The aerial feed system is contained in this copper-lined room, which has the atmosphere of having been created by a mad scientist. The transmitter proper is behind the right-hand wall. No one is allowed in this room when the station is on the air. Attendants can work safely elsewhere, by taking suitable care.

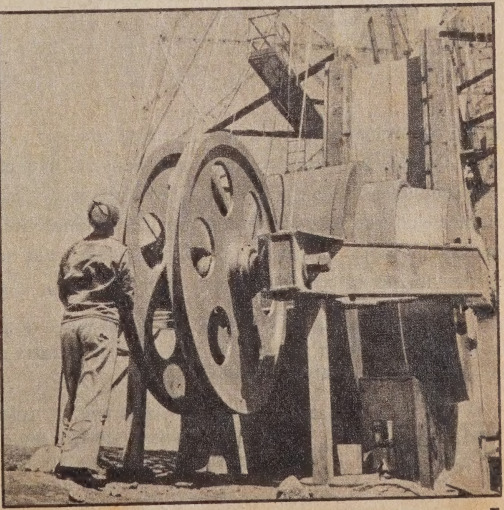
* * *



The output transformer (radio amateurs would call it the "tank") is twice as tall as a man. It is wound as a toroid, using slanted copper strips. All wires, joints and surfaces in the entire RF output circuit have to be kept free from imperfections which might cause ionisation discharge, leading to loss of power or actual physical damage.



Individual towers, as shown above, soar as high as 980 feet. Wires run over pulleys atop some of the towers, down to counterweights sliding on shorter, inclined, supplementary towers.



At right is one of the huge counterweights, made from special dense concrete and weighing 220-tons. Weight of the antenna will carry it aloft, hanging from a double sheave. In a high wind, the counterweight may move up and down the tower faces by a couple of hundred feet.

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The other plate of the capacitor is the earth, more than 800 feet below. Together, they "load" the vertical broadcasting element, which stretches between them, so that it works efficiently.

About half the electrical energy supplied the two antenna arrays gets out as signal — one million watts of radiated power. If that were 60-cycle AC, it could light up every house for miles around, including the county seat, Machias, pop. 1,621.

All the electricity that flows into the top hat has to get back through the ground. Dirt is a poor conductor, and Maine dirt is worse than most. "We'd copper-plate the whole peninsula if we could afford it," remarked a Navy engineer.

WORSE THAN MOST

What they did comes pretty close. They laid 2,000 miles of No. 6 bare copper wire into a screen (every crossing individually brazed) that is buried about a foot below ground. It covers the peninsula and runs down into the ocean on all three sides—seawater is a good conductor.

The monstrous antenna system gets its broadcasting signals off coaxial cables as big as sewer pipes, laid in six-foot underground tunnels. They run to the transmitter house, a concrete pillbox midway between the two antenna arrays.

It resembles a big-city radio station—until you compare sizes. There are four final amplifiers, 500,000 watts each. The vacuum tubes are two feet high. They're installed in duplicate, with the spares always hot and ready to operate. Coils are wound of copper pipe that a plumber could use.

And the transformer . . . The one in your TV set fits in your hand. This one looks like a water tank for the roof of an office building.

With 2,000,000 watts of low-frequency electricity running around, you might expect the whole station to crackle like an earth-bound thundercloud. Its builders devoutly hope it will not.

They handled the top-hat cables, made of bronze alloy an inch and more thick, as though they were fragile glassware. Even a nick 1/16 inch in the surface would generate a blue-glowing arc, wasting power.

MANY PRECAUTIONS

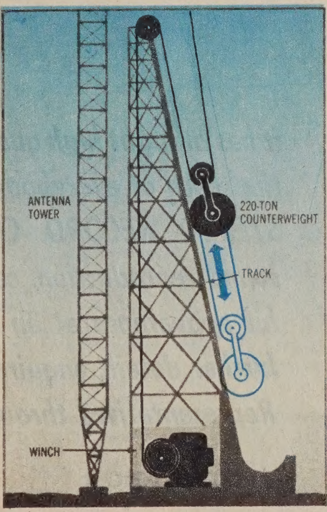
Everywhere there are elaborate precautions. Everything, including the steel reinforcement of concrete buildings, is grounded several times. All buildings are roofed with copper, which is grounded. The helix houses, where the coaxial feed cables are coupled to the antennas, are lined with aluminium, every seam welded.

The huge gallery that carries transmitter power from the output transformer to the co-ax is completely lined with copper—floor, walls, ceiling. No combustibles (such as wood or people) are permitted there; they would bake to a crisp.

Still, the engineers expect no special hazards. The Navy has operated similar, if somewhat less powerful, radio stations for many years. Maintenance crews will work in the antenna field, while NAA broadcasts.

TWO THOUSAND MILES OF WIRE

To bury the ground wires, a bulldozer was adapted to plough a furrow and lay the heavy wire in it, all in one operation. Wires are buried mainly to protect them from physical damage.



Illustrating the winch and counterweight system which will keep the aerials aloft.

For one thing, 2,000-odd acres of grass must be mowed, since tall growth hinders transmission. The technicians will have to learn the approved technique for getting out of their trucks: You jump off with both feet. Substantial voltage will be induced in steel truck bodies.

Anybody who climbs down in the usual way will get knocked flat on his face.

Few people live near the site, and their home activities will not be affected by the superpower transmitter, the Navy says. This reassurance is considered a bit glib by outsiders, who remember the tales of radio witchery told by neighbours of much weaker stations (hearing aids that pick up signals, house lights that can't be turned off).

The most powerful radio station in the world will put a 100 million dollar bite on U. S. taxpayers. It costs so much because the Navy needs to send messages through water.

ABSORBS RADIO WAVES

Nature has made that uncommonly difficult. It's a strange fact that a puny transmitter, emitting a few watts, can signal to earth from a space probe beyond the sun, while 2,000,000 watts are needed to reach a sub submerged off our coast.

Water absorbs radio waves the way smoked glass absorbs light. Long waves (low frequencies) get through more easily than short waves. Besides, long waves give wide and reliable coverage, spreading over the surface of the earth (NAA will also handle messages for surface ships and shore stations).

Unlike short waves, they do not have to bounce back and forth off charged layers in the atmosphere, often messed up by sunspots.

That's why NAA broadcasts the longest practical waves (6 to 20 miles). Still longer waves would be better but would require an impossibly high antenna. The new station is an economic compromise, bolstering the water-penetrating ability of its wavelength with tremendous power.

Even NAA, for all its costly power and wavelength, can send signals only about 30 feet deep into the ocean. Talking to submarines is expensive.

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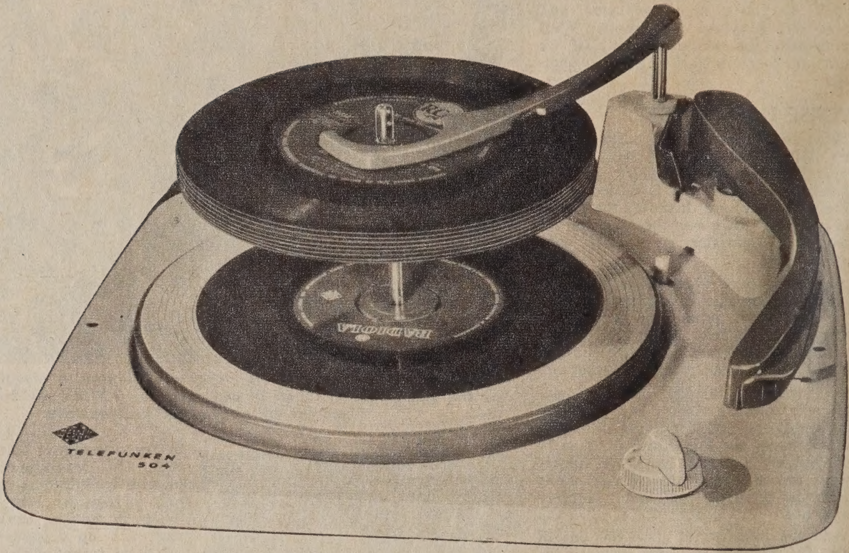

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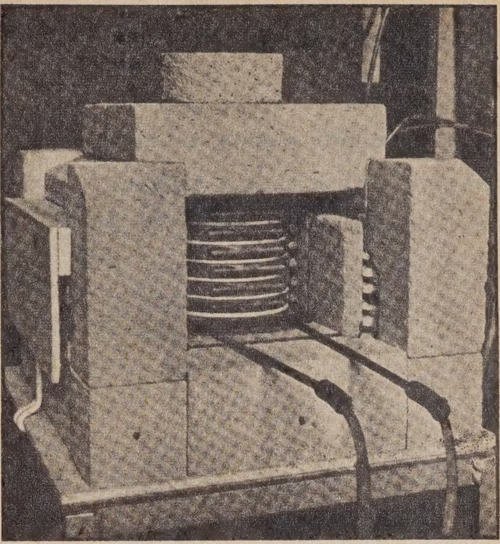
FUEL CELLS

* British Research Continuing

Much interest has been aroused by recent investigations into the possibilities of using fuel batteries as a source of electrical energy. This article reviews the history of the process and considers theoretical applications.

By H. H. Chambers



The picture above shows an experimental high-temperature fuel battery in operation at Sondes Place Research Institute.

ELECTRICITY production is commonly regarded as a process of power generation. It is more correct to call it an energy transformation process, because all methods of making electricity involve transforming some form of stored energy into electrical energy.

But here I am concerned only with the conversion of the stored chemical energy of fuel into electricity.

All energy transformations are governed by the Laws of Thermodynamics. With one exception, any form of energy may be converted into any other form with an efficiency of 100 per cent.

DEFINITE EFFICIENCY LIMIT

The exception is the conversion of heat into mechanical work where, by reason of the special nature of heat energy, it is impossible to convert more than a certain definite fraction of a given amount of heat into mechanical energy.

One of the important consequences of the Second Law of Thermodynamics is that even a perfect heat engine (i.e. steam engine or turbine) cannot convert more than about 65 per cent of the heat fed to it into mechanical energy, the remainder being discarded as useless heat at atmospheric temperature.

For this reason energy is said to be "degraded" when it is converted into heat and thereby loses some of its capacity for doing useful work.

Figure 1 shows two routes from chemical energy of fuel to electrical energy.

In the upper route, the conventional method of electricity production, the overall efficiency rarely exceeds about 30 per cent and is governed by the degradation to heat which occurs in the first stage. In the lower route, the fuel cell, there is no heat stage and hence no limit on the efficiency.

It is of some interest to consider why very little serious work was done on fuel cells until the mid-twentieth century. The fundamental laws of electro-chemistry were discovered by Faraday, as were the laws of electro-magnetic induction. The latter led to the development of the dynamo at a time when steam engines were being widely used as prime movers and the science of thermodynamics was imperfectly understood.

REVERSING ELECTROLYSIS

The possibility of producing electricity by a reversal of the process of electrolysis was known at an early date and, in 1839, Sir William Grove produced a hydrogen-oxygen fuel cell.

It was only after the development of thermodynamics into an exact science that the full potentialities of fuel cells were appreciated. By then the heat engine process of generating electricity was well established and fuel was still cheap.

The early work up to the 1920s reveals an imperfect grasp of the problems involved, in spite of the fact that Mond and Langer as far back as 1898 had constructed a hydrogen-oxygen cell embodying several features of a modern fuel cell.

Progress between the two world wars was slow, mainly because of limitations of the available materials of construction and lack of satisfactory techniques for making durable electrodes. Since 1945 there has been a revival of interest in fuel cells prompted by rising costs of power and increasing need to conserve fuel.

One of the most successful cells, the Bacon cell, was developed in Britain. Mr F. T. Bacon, an engineer, became interested in fuel cells in 1932 and quickly came to the conclusion that the problem would have to be attacked

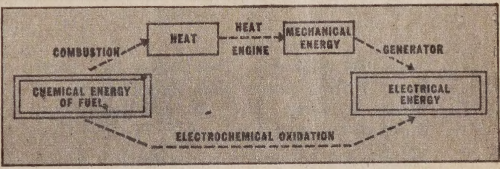
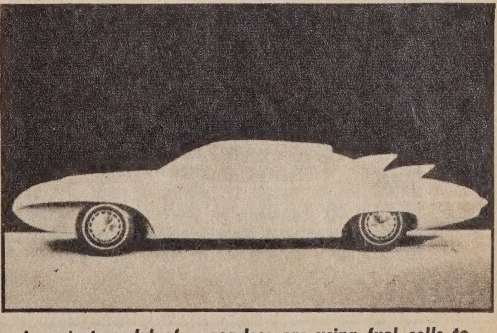


Figure 1: Illustrating the two methods by which the chemical energy present in fuel can be converted to electrical energy.



A project model of a gearless car using fuel cells to drive four lightweight motors each connected to one wheel. The design eliminates much of the weight and wear of the present conventional car.

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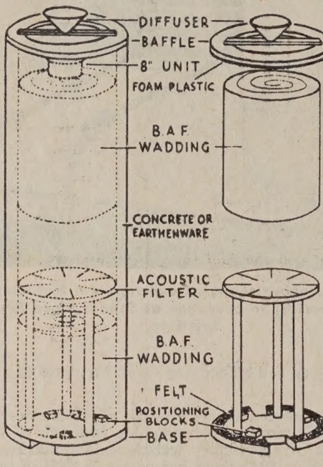

THE

CIRCULAR COLUMN SYSTEM

AT THE

LONDON AUDIO FAIR 1960

During the Wharfedale Demonstration the Circular Column System illustrated above created an enormous amount of interest, and as a result constructional details are now given.

The drainpipe used was in porous concrete and can be bought from builders' merchants at a low cost. Alternatively, pipes of glazed earthenware or spun concrete can be used.

The pipe is 3ft. long, 9in. inside and 11in. outside diameter, and weighs 106lb.

Inside is an acoustic filter standing on three legs and two rolls of B.A.F. wadding (to counteract the circular shape effects). There is a circular baffle at the top with diffuser, and a wooden base with suitable vent openings. It was necessary to use some plaster on each end of the pipe in order to obtain a level surface for an airtight fit. (Plasticine could also be used for this purpose.) The underside of the baffle is fitted with a layer of foam plastic, and the circular base has a layer of felt on which the pipe rests.

COMPONENTS:

A complete kit containing all components (other than the pipe) is available from all progressive Hi-Fi Dealers. The kit comprises: Wooden base; acoustic filter; circular baffle and strut for diffuser; two rolls of B.A.F. wadding; and the Aluminium diffuser.

THE PIPE:

Arrangements have been made with Messrs. Humes Limited who can supply the concrete pipes in each capital city and in leading provincial towns throughout Australia.

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from the viewpoint of the engineer rather than the electrochemist.

This was an important decision which had much to do with his later success.

In reading the early literature one is struck by the fact that the great majority of the cells described are mere laboratory curiosities. By 1939 many cells capable of giving a small output for a limited period had been described, but nobody other than Bacon had given any serious consideration to the engineering problems of designing a commercially acceptable fuel battery.

Bacon resumed his work after the war in the Chemical Engineering Department at Cambridge with the support of the Electrical Research Association, the Ministry of Power, and the Admiralty.

The National Research Development Corporation assumed financial responsibility when the work reached the development stage and a contract placed with Marshalls of Cambridge led to the construction of the three-kilowatt unit demonstrated publicly in August, 1959. This was the first high-performance fuel battery ever to emerge from the laboratory stage of development.

NEEDS HYDROGEN, OXYGEN

The Bacon cell operates only on hydrogen and oxygen. If the fuel cell is ever seriously to compete with conventional methods of producing electrical power it must be made to run on orthodox fuels such as producer gas, natural gas, or vaporised liquid hydrocarbons.

In 1953 with this object in view an independent program of exploratory research was initiated at the Sondes Place Research Institute, Dorking, under a contract from the Ministry of Power and the Central Electricity Authority.

The feasibility of running cells at high temperatures on these fuels was demonstrated at an early stage and the research was continued with additional financial support from Shell Research Ltd.

The work has not yet reached such an advanced stage as the Bacon cell, but prototype batteries with outputs of several kilowatts are now being developed at Dorking under the auspices of the National Research Development Corporation.

The Bacon cell and the Sondes Place cell are different in conception and have different potential uses. They both have efficiencies of 60-70 per cent but, whereas the Bacon cell operates on a rather specialised fuel at 200 deg. C. and 400lb per square inch pressure, the Sondes Place cell consumes almost any type of gaseous or vapourised liquid fuel at 500-700 deg. C. and atmospheric pressure.

The Bacon cell has a substantially higher performance in terms of power output per unit area of electrode and its main use is likely to be as part of a high-efficiency electrical storage system using hydrogen and oxygen produced by electrolysis of water.

It would, of course, be equally effective as an indirect fuel cell running on hydrogen produced chemically from the primary fuels, oil or coal.

The Sondes Place unit can be run as a direct fuel cell on liquid hydrocarbon fuels or natural gas, or as an indirect fuel cell on carbon monoxide-hydrogen mixtures produced from coal.

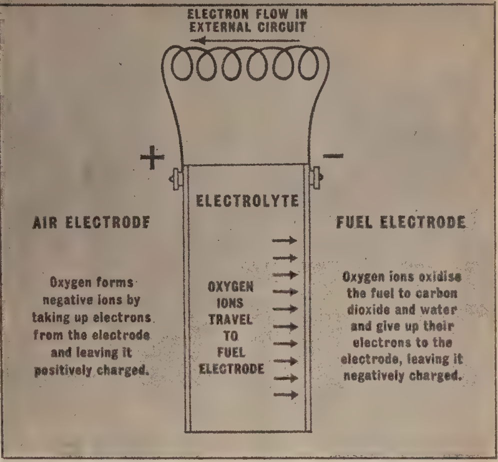
WILL COMPARE FAVOURABLY

Research has shown that the inherent high efficiency of fuel cells can be taken for granted and the future will be decided by the success of efforts to develop larger units which compare favourably with conventional processes in respect of cost, power/weight, and power-volume ratios, and reliability.

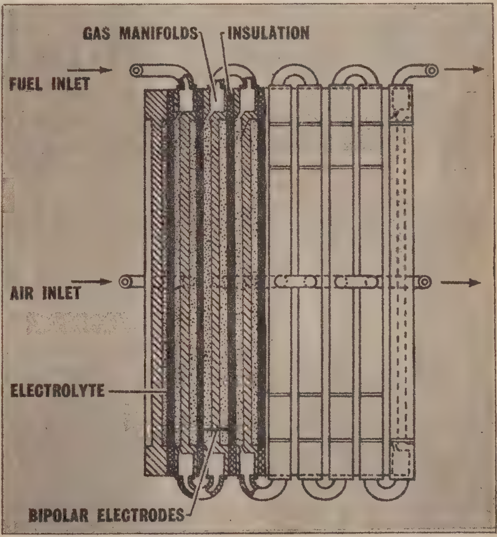
This calls for sound engineering design rather than fundamental research and the outlook is very bright. It is fairly certain that fuel batteries will become a commercial proposition within the next few years, either on the basis of current work in Britain or as a result of parallel work which is being actively pursued in the United States, Germany, the Netherlands and the U.S.S.R.

Until the first commercial units are produced it will not be possible to say with certainty where the main applications lie. Consideration of possible applications provides useful target figures for cost and performance.

HOW FUEL CELL OPERATES


ELECTRON FLOW IN EXTERNAL CIRCUIT
+
−
ELECTROLYTE
AIR ELECTRODE
FUEL ELECTRODE
Oxygen forms negative ions by taking up electrons from the electrode and leaving it positively charged.
OXYGEN IONS TRAVEL TO FUEL ELECTRODE
Oxygen ions oxidise the fuel to carbon dioxide and water and give up their electrons to the electrode, leaving it negatively charged.

In the fuel cell the fuel is oxidized by oxygen ions and the energy released appears as an electric current instead of heat.



An eight-volt Sondes Place battery. Each bipolar electrode is fed with air on one side and fuel on the other.

However, the right way to look at this new development is not as a method of producing electricity for specific purposes, but as a revolutionary new process of power production.

Fuel cells are very simple devices eminently suited to inexpensive mass production techniques and there is no reason in principle why the objectives mentioned in the last paragraph should not be achieved. If they are, a very great variety of uses can be envisaged.

They range from replacement of diesel generator sets and storage batteries for power supplies in remote areas to large-scale generation of electricity for electro-chemical industries; from small electrically driven gearless motor cars or delivery vehicles to electric rail-cars; and from powering mobile radar equipment to powering satellite radio transmitters.

Pills for the nation's ills. This electronic counter feeds just the right number of aspirins into each bottle at Sterling Pharmaceuticals.

How Our Chemicals Are Made

Every day we buy and use things from packets, tins or bottles. We might even be aware of the chemical make-up of some of these things but few ever stop to consider how they came to be made in the first place.

by Calvin Walters

MUM puts bicarbonate of soda into the cakes and scones to make them "rise." Dad swallows it by the spoonful to ease his indigestion after, maybe, eating the above cake or scones or after a night out with the boys.

In the home, vast quantities of soaps are used.

Of late years another type of cleansing agent has made its appearance, namely the detergent. Our ears have been assailed by songs about new whitening and brightening discoveries, no wiping up, no scum around the bath tub, no soapy film left in the clothes after wash day, everything cleaner, whiter, brighter, with half the effort and time.

The battery of our car contains a solution of sulphuric acid, one of the most vital chemicals of modern times. It is used also in the manufacture of fertilisers, and in the production of dyes, artificial fibres, explosives. It is used in the refining of petroleum oil and the so-called "pickling" of metal prior to other processes such as galvanising.

"SPIRITS OF SALTS"

When the plumber comes to mend the leaky roof he uses hydrochloric acid commonly called "spirits of salts" as a flux to assist him in soldering the iron roof or guttering. This is another important acid used extensively in industry.

Then there are such chemicals as caustic soda and washing soda, the vast arrays of chemicals used for making glass; the chlorides of lime for deodorants and germicides, and the compounds used in electroplating and beautification of the metal articles used in commerce and the home and in milady's handbag.

We have the chemicals used in the manufacture of modern drugs and anesthetics — in the new "tranquillisers" for top executives or those suffering from financial or domestic worries. There are the aspirins, which is acetysalycylic acid together with phenacetin and caffeine to make up the millions of A.P.C. powders to cure the millions of modern headaches.

IN MEDICINE

In medicine there are the sulfa drugs which are chemical compounds, the many chemicals used in tonics including arsenic, potassium, strychnine, sodium, manganese, carbon, quinine and so on.

Our house flies and mosquitoes are eradicated with chemicals, rats and mice are poisoned with chemicals; our fruit trees are protected with chemicals, indeed, our clothing, food, footwear and so on are now made with chemicals.

One might well argue that chemicals are the most important things in our lives and it wouldn't be far from the truth. They are the basis of the living body itself. We keep alive by chemical reactions in our bodies, while the material things of life are mostly products of chemical reaction.

Where, then, do all these chemicals that we use come from? They are for the most part manufactured in vast chemical works by means of chemical reactions in specially designed apparatus.

Space will not permit me to describe the manufacture of the vast number of chemicals, so I will select just a few of the most interesting processes. Since I mentioned that sulphuric acid was one of the most vital chemicals, I will start with that one.

As all schoolboys know who have done some chemistry the chemical formula for sulphuric acid is H_2SO_4. In other words it consists of two parts of hydrogen, one part of sulphur and four parts of oxygen in chemical combination. One doesn't get sulphuric acid, however, by merely mixing hydrogen, oxygen and sulphur in a bottle!

They must be chemically combined and the method of combining them is a very interesting example which is worth relating in some detail.

There is a gas called sulphur trioxide, the chemical formula of which is SO_3, or one part sulphur and three parts oxygen. This combines readily with water H_2O so that adding the quantities of hydrogen, sulphur and oxygen together we get H_2SO_4, or sulphuric acid.

The question is how do we get the sulphur trioxide SO_3. The best way is to take sulphur dioxide (SO_2) and add another part of oxygen to make SO_3. Sulphur dioxide will not combine readily with water. It is a gas obtained by heating iron pyrites (sulphide of iron), or collecting it as a by-product in smelting works.

TO SULPHUR TRIOXIDE

The process of adding oxygen to anything is called oxidisation, so what is done is to oxidise sulphur dioxide by hitching another atom of oxygen to it, thus converting it to sulphur trioxide.

But the problem of hitching this extra atom of oxygen was not easy of solution. It requires some heat to hasten the process of combination and, as the heat is raised, the combination takes place at an increasing rate.

On the other hand when the heat is raised to the extent where the combination would take place sufficiently rapidly to provide sulphur trioxide in commercial quantities, the extra heat decomposes the sulphur trioxide back into sulphur dioxide and we are back where we started.

The solution of the problem lay in the use of what, in chemistry, is called a catalyst.

The word "catalyst" has nothing to do with cats. It is derived from the Greek and means an agent which loosens or sets free something else. But don't get me wrong. Someone who opens the bird cage and lets the bird out, or one who lets the dog off the chain, is not a catalyst. We don't use the term in that way.

In chemistry there are many substances which, if introduced into a mixture of chemicals or gases, will set off a chemical reaction, while themselves remaining unchanged. A good example of this is the metal platinum.

IGNITES GAS

In 1817 Sir Humphrey Davey discovered that, if a platinum wire was introduced into alcohol or ether vapour, the latter reacted violently with the oxygen of the air on the surface of the metal, which became red hot.

In this case the platinum acted as a catalyst and remained unchanged, even though the alcohol or ether vapour was burnt. This process is used today in one form of gas lighter containing platinum sponge. When inserted into gas issuing from a burner, the platinum becomes red hot and ignites the gas.

The subject of catalysis is a very interesting one, but too comprehensive to deal with here. At some later date, maybe, we will go into the matter in detail.

The gases nitric oxide, nitrogen dioxide and compounds of vanadium are good catalysts for use in the making of sulphuric acid.

The idea of using a catalyst is to hasten the process of hitching the extra oxygen atom on to our sulphur dioxide at a low temperature and at a rate commercially profitable.

In one process called the "lead chamber" process, the sulphur dioxide is passed through large lead chambers in the presence of air and nitric oxide, whose formula is NO (one part nitrogen and one part oxygen).

SULPHURIC ACID

In the chamber the nitric oxide combines with the air, stealing one atom of oxygen and becoming nitrogen dioxide (NO_2). This latter then gives up one atom of oxygen to the sulphur dioxide which becomes our sulphur trioxide and the nitrogen dioxide goes back to nitric oxide (NO) because it has lost its extra atom of oxygen. The sulphur trioxide then combines with water to form sulphuric acid.

Thus there is a continuous cycle where nitric oxide (NO) becomes nitrogen dioxide (NO_2), loses one atom of oxygen to sulphur dioxide (SO_2) which becomes sulphur trioxide (SO_3) and the nitrogen dioxide reverts to nitric oxide to be used over again.

AN ENDLESS WAR AGAINST "WOGS"

Huge quantities of chemicals are used by Australian primary producers. Here apple trees at Mount Canobolas (N.S.W.) are sprayed to prevent ravage by the codlin moth.

In this "lead chamber" process, the equipment required is very cumbersome. In some plants the chambers were at least of 100,000 cubic feet capacity. The sulphuric acid produced was about 65 per cent and needed further processing by purification and concentration before the pure acid was obtained.

Another process called the "contact" process makes use of smaller vessels containing the catalyst. This is usually a compound of the metal vanadium. The sulphur dioxide is passed into these chambers at a temperature of about 450 degrees Centigrade. The compound of vanadium converts the sulphur dioxide into the wanted sulphur trioxide which is fed through a solution of acid of higher concentration. Pure acid is obtained in this way.

I have described the manufacture of sulphuric acid in some detail to give some idea of the process of catalysis and to indicate the great trouble taken to manufacture this important chemical for use among other things, in the battery of your car.

While on the subject of acids, there may be some plumbers who would like to know how their "spirits of salts" or hydrochloric acid or muriatic acid is made.

This is a much simpler process than the manufacture of sulphuric acid. It consists of heating sodium chloride with

Chemicals and chemical processes feature large in the kitchen every day of the week—but under different names. Vegetables are liable to taste very "flat" for example, unless sprinkled with a little sodium chloride.

Technicians and experimenters throughout Australia know the value of Hansen meters.

Two new meters have now been added to the range for transistor servicing—The DMM-5 and the DMV-5.

Hansen

Ordinary voltmeters and milliammeters cannot be used for transistor service work and millivoltmeters and microammeters are essential for anyone working in this field.

The DMM-5 is a D.C. microammeter with five ranges: 0-30 uA, 60 uA, 120 uA, 300 uA, 600 uA, FSD.

The movement sensitivity is 20 uA and the calibration accuracy is plus or minus 1.5%.

The DMV-5 is a D.C. Millivoltmeter, also with five ranges: 0-30 mV, 60 mV, 120 mV, 300 mV, 600 mV FSD.

The movement sensitivity is 510 uA and the calibration accuracy is plus or minus 1.5%.

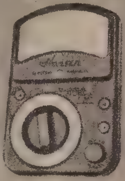
The DMM-5 is almost identical in appearance to the DMV-5 (shown at right).

MILLI VOLT METER

Prices: DMV-5 £9-8-6 (plus tax) f.o.b./f.o.r. Sydney.

DMM-5 £12-2-6 (plus tax) f.o.b./f.o.r. Sydney.

Abbreviated details of some of the other instruments in the range are:



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Direct current to 300 mA.
Resistance to 200 Meg.
Also measures capacitance, inductance, decibels.
PRICE: £7/11/6
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MODEL TS-m.
10,000 opv. D.C. 4,500 opv. A.C.
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Direct current to 140 mA, A.C. to 200 uA.
Resistance to 5 Meg.
Also measures capacitance, inductance, decibels.
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MODEL FN:
20,000 opv. D.C. 5,000 opv. A.C.
A.C. and D.C. voltage ranges to 700v.
Direct current to 140 mA.
Resistance to 50 Meg.
Also measures capacitance, inductance, decibels, RF voltage.
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MODEL M100:
33,300 opv. D.C. 15,000 opv. A.C.
A.C. and D.C. voltage ranges to 600V.
Direct current to 12A. A.C. also to 12A.
Resistance to 1,000 Meg.
Also measures capacitance, decibels.
PRICE: £30/10/
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MODEL M70:
33,000 opv. D.C. 15,000 opv. A.C.
A.C. and D.C. voltage ranges to 3,000v.
Direct current (and A.C.) to 12A.
Resistance to 200 Meg.
Also measures capacitance, inductance, mutual conductance, decibels, RF volts (r.m.s. and p/p).
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sulphuric acid (sodium chloride is common salt). This converts the sodium chloride into sodium sulphate, a chemical used in the manufacture of glass.

During the heating process considerable volume of hydrochloric acid gas is given off, which is very soluble in water. Thus, when this gas is fed through water, it is dissolved in the latter and becomes our hydrochloric acid.

Strangely enough, the important nitric acid is now manufactured from one of the strongest alkalis, namely ammonia. Nitric acid is used in the manufacture of explosives and is an important chemical needed in the production of nitric oxide, as described above for the manufacture of sulphuric acid.

NITRIC ACID

When ammonia and air is passed over platinum wire gauze at a temperature of 800 degrees Centigrade the wire gauze acts as a catalyst causing the ammonia to react with oxygen to form oxide of nitrogen which, dissolved in water becomes nitric acid.

Thus our friend the catalyst helps us again.

If this reaction is suitably controlled, a well-known fertiliser is obtained in the form of ammonium nitrate.

Speaking of ammonia, how is this made? We have all used this pungent chemical at some time or other, either in the form of cloudy ammonia, a mixture of ammonia and soap, or maybe in the form of "smelling salts" or ammonium carbonate.

The modern process of making ammonia relies on the fact that, when hydrogen and nitrogen are mixed under certain conditions, they react to form ammonia. Again a catalyst is used to hasten the reaction. Several catalysts are available for the purpose, the most important beng oxide of iron, molybdenum, potassium oxide and the metal osmium.

The hydrogen and nitrogen gases are mixed in a chamber at a pressure of about 150 times that of the atmosphere. Inside the chamber the catalyst is heated to about 500 degrees centigrade. This brings about a reaction between the nitrogen and hydrogen and ammonia is produced, as a gas mixed with the other two.

This ammonia gas is either condensed at a low temperature from the other gases or passed through water where it dissolves out and leaves the other two gases to pass back into the chamber to repeat the process over again.

LAWNS LOOK GREENER

The well-known ammonium sulphate, used as a fertiliser or as an agent to make the lawn look greener, is often made by treating a mineral called calcium sulphate or anhydrite, with ammonia and carbon dioxide. This forms into ammonium sulphate and calcium carbonate. The latter is used to "lime" garden soil.

Now what about the baking soda (sodium bicarbonate) used for cooking and indigestion, and sodium carbonate (washing soda) used in the laundry?

If you take a solution of ordinary common salt (sodium chloride) which has been saturated with ammonia, and pass carbon dioxide through it, sodium bicarbonate is precipitated. This is baking soda. If you want sodium carbonate or washing soda the bicarbonate is heated whereupon the carbon dioxide and the water are forced out of the mixture leaving behind sodium carbonate.

In soap making, large quantities of caustic soda are used to convert fat and oils into a condition which will exhibit the well known properties of soap.

Caustic soda is made in two ways. The one which has been used for centuries uses sodium carbonate (washing soda) boiled with slaked lime (a calcium salt). Both these substances are decomposed with the result that the washing oda becomes sodium hydroxide (caustic soda) and the slaked lime becomes calcium carbonate. The latter will not dissolve in water and therefore separates out from the liquid and can be recovered.

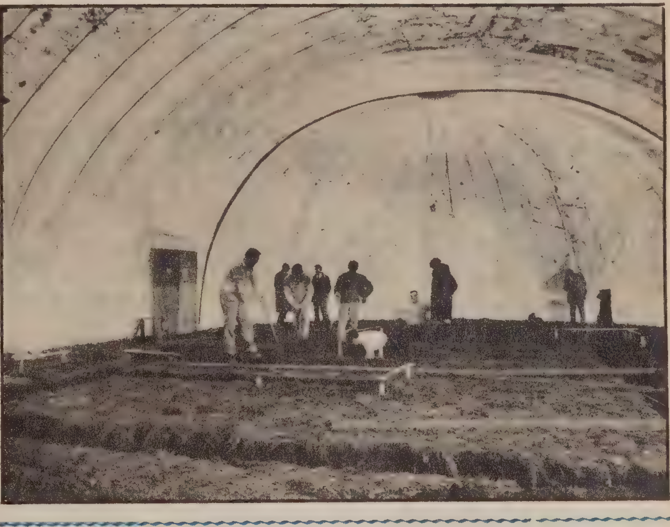
Another process which is steadily growing in favour is the electrolytic process. Valuable by-products in the way of the gas chlorine and hydrogen make this process all the more valuable. Chlorine is used as a bleaching agent and in the manufacture of insecticides, dyes and the sterilisation of water in swimming pools.

The electrolytic process involves the use of large enclosed tanks containing a solution of common salt (sodium chloride). Graphite rods which serve as

(Continued on Page 109)

NO ONE GETS WET ON THIS JOB

Workmen in Middlesex used this new British Airhouse for the first time to speed the construction of a conventional dwelling. Completely covering the site, the Airhouse allows work to continue, irrespective of weather conditions outside. No supporting poles are required, the nylon envelope being simply pegged down and supported by a supply of low pressure air.



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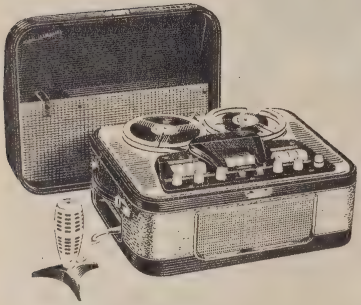

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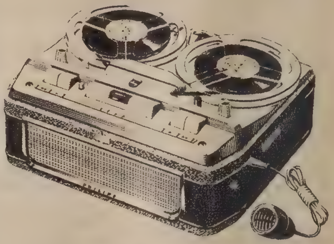

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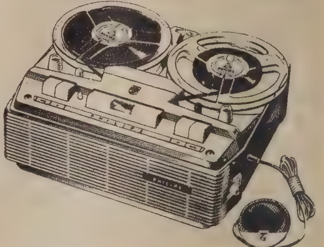

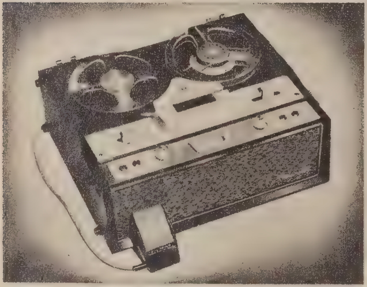

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A-26B NOW EXECUTIVE TRANSPORT

Completion of ingenious modification work has transformed the wartime Douglas A-26B bomber into a luxurious, high-speed, high-performance transport aircraft capable of carrying up to 14 passengers and 400 pounds of baggage.

DESIGNATED the "Silver Sixty," the aeroplane is undergoing flight test trials in southern California.

Developed by Rhodes Berry Company, aviation consulting engineers of West Los Angeles, and priced below any comparable aircraft, this new design is expected to make a heavy impact on the business and corporate plane market, when production models roll off the assembly lines.

In addition to low cost, the Rhodes Berry design offers many marked improvements unavailable until now in B-26 modification designs. The original full-strength wing spar structure has been retained by adding a deeper "lower half" fuselage. Height from cabin floor to ceiling is six and one-half feet, providing plenty of headroom. The usable cabin length is 22 feet.

AMPLE SEATING

This roomy interior accommodates two rows of single seats; a spacious lounge; a 14 inch walk-through aisle, and large view windows placed at eye level. The completely new conocoque fuselage structure of the "Silver Sixty" permits a large passenger entrance door located on the left side of the fuselage. A separate crew and baggage door forward eliminates servicing the aeroplane through the passenger compartment.

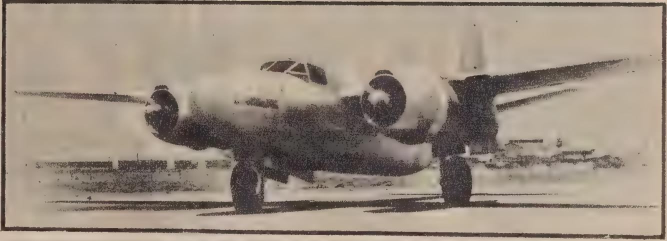
Contours of the "Silver Sixty" are aerodynamically clean. They bear no resemblance to the original lines. All areas of undesirable separation inherent in the original military configuration have been eliminated, with a resultant decrease in drag.

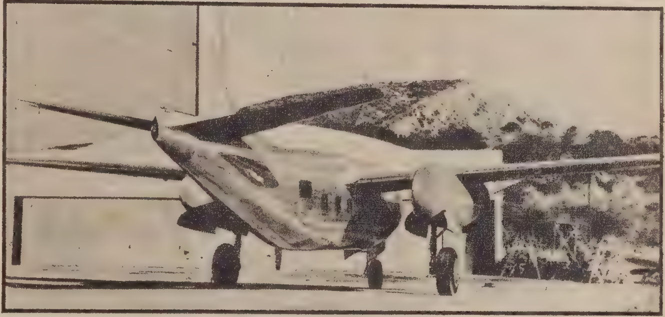
Another important achievement is the reduction in size of the nosewheel doors. Straight retraction of the nose wheel without turning the wheel flat to the airstream has been achieved. This, coupled with fast-acting small-area doors, greatly improves take-off. Rhodes Berry states there is no possibility of malfunction to necessitate a landing with the nose gear in crosswise position.

In addition to a variety of plush executive cabin interiors available, the "Silver Sixty" is equally adaptable to cargo versions with a drop down cargo loading ramp in the aft section.

Powered by Pratt and Whitney R-2800 engines, "Silver Sixty" cruise speeds have been established by test in excess of 300 miles per hour. More powerful CB-16 engines, available as optional equipment, will boost the cruising speed to 365 miles per hour.

With a gross take-off weight of 35,000 pounds, the "Silver Sixty" can fly Los Angeles-Chicago in less than five hours with extended fuel provisions.





First pictures of the prototype "Silver Sixty." It is suggested that the plane could revert to military service, and be used to carry up to 20 paratroops.

Weather radar, anti-skid brakes, nose-wheel steering, and extended range fuel tanks will be available as optional equipment.

Our Cover Picture

FIRST FLIGHT OF BOEING-VERTOL 107

A NEW era in helicopter transportation was ushered in recently with the first flight of the Boeing-Vertol 107. The result of a completely new concept in helicopter design, the 107 is said to be the fastest, smoothest and most versatile helicopter flying today. The one pictured was converted from an Army YHC-1A.

The conversion resulted in an uprating of the dynamic system from 1,700 to 2,300 horsepower. A new transmission and a completely new rotor system have been installed to accommodate the increased power of the GE-T58-8 engines. Other conversion changes include a redesigned control system for improved reliability, and modifications to the airframe to permit quick conversion from airliner to utility configuration.

The Boeing-Vertol 107 is the culmination of a four-year program to produce the best configuration for a medium transport helicopter in the turbine era of the 1960s. Powered by two General Electric CT58 shaft turbines, it can carry 26 to 30 passengers or troops and cruises in excess of 155 m.p.h.

The 107 is the first helicopter designed to meet the requirements for all military and commercial operations. Its twin engines provide greater reliability and permit all-weather operations. It has a unique rear-loading ramp which gives the aircraft a fully usable cabin.

Special safety features are the location of the fuel outside and of the two turbine engines aft of the passenger cabin. The 107 can land and take off from water without special boat-hull design or flotation gear added. It also has improved maintenance features which result in lower service costs.

The versatility of the 107 is also demonstrated in its ability to perform many commercial operations, such as work crew transport, flying crane work, towing or airlifting construction equipment, wire stringing, logging operations and other cargo transport.

The airliner version of the 107 has an exclusive removable baggage unit which fits into the rear cabin area and rolls in and out like a drawer for rapid baggage handling.

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Super-Impose switch.
Can be used For Public Address.
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Major Specification

TAPE	¼" double play
NUMBER OF TRACKS	Two, to British Standard Recording sense
NUMBER OF MOTORS	Three, 4 pole induction
OPERATING SPEEDS	1⅞, 3¾, 7½ inches per second
WOW AND FLUTTER	Not greater than ·15% at 3¾ ips
LONG TERM SPEED STABILITY	Better than ·5%
RE-WIND AND FAST FORWARD	Approximately 2 minutes (2,400 ft.)
TAPE POSITION INDICATOR	Digital Counter with Zero Reset
HEADS	One Record/Play (3 micron gap) One Erase
FREQUENCY RESPONSE	50 — 20,000 c/s at 7½ ips ± 3 dB 50 — 14,000 c/s at 3¾ ips ± 3 dB 50 — 7,000 c/s at 1⅞ ips ± 3 dB
AMPLIFIER OUTPUT	6 watt push-pull
SIGNAL TO NOISE RATIO	Better than 43 dB unweighted
VALVES	8 D8, ECL82, ECL82, ECL82, E1760 Metal Rectifiers
BIAS FREQUENCY	64 kcs
RECORDING LEVEL INDICATOR	Moving Coil Meter
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Technical Review

UNIQUE TRANSFORMER—NEW BASIC PRINCIPLE

In the trend towards smaller and lighter electronic equipment one component, the transformer, has proved a stumbling block. The materials from which it is made are naturally heavy, while there is a limit to the miniaturisation possible without seriously degrading performance. This article, by A. E. Crawford (M.Brit.I.R.E., S.M.I.R.E.), of the Brush Crystal Co. Ltd., tells of a completely new approach to the problem.

THE first serious attempt to provide a replacement for the electromagnet transformer has now been made possible by the development of lead zirconate-titanate piezo-electric ceramics.

When a piezo-electric material is subjected to mechanical strain, an electric charge appears across selected electrode faces. Similarly, there is the converse effect when a voltage is applied to the electrodes.

NATURAL RESONANCE

All mechanical structures possess resonant modes of vibration corresponding to their physical properties and structural dimensions. At these resonances the strain produced by the applied vibrating force rises to a maximum due to the standing wave distribution.

When a piezo-electric resonator is energised by an applied voltage of a frequency corresponding to the natural resonant frequency, then the maximum mechanical deformation will occur.

The piezo-electric transformer uses these principles to obtain a change of voltage. If two piezo-electric elements are mechanically coupled together, it is possible to introduce a strain in one element by electrically energising the other at a frequency corresponding to the natural resonant frequency of the combined system.

This principle is not new and is, in fact, used on a number of resonating devices where the output signal maintains the system in self oscillation.

SUITABLE CERAMIC

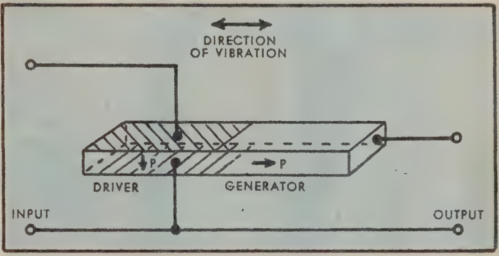
The recent introduction in England of a Brush piezo-electric ceramic based on the lead zirconate-titanate solid solution enables this system to be produced in a unique manner. A diagrammatic representation is shown in the accompanying drawing and consists basically of a bar of ceramic performing both driving and driven functions.

Piezo-electric ceramics can be preferentially polarised, that is, the direction of piezo-electric activity is predetermined by the electrostatic field used initially to align the piezo-electric domains. One half of the block is polarised in the thickness direction and the other half in the length direction.

☆

Illustrating the basic principle of the piezo-electric transformer. The driver unit (left) vibrates in a vertical plane and the generator in horizontal plane.

☆



VERY ACTIVE

With L.Z. ceramics, there is a large amount of piezo-electric activity at right angles to the energising field, and the bar can be excited into length resonance when an alternating voltage is applied across the thickness electrodes. This produces a strain in the length polarised half of the bar, and consequently a voltage is generated by the direct piezo-electric effect.

Since it is possible to have a large ratio of impedance presented by the two halves of the bar, there will be a voltage step-up. This is also affected by the mechanical efficiency of the system and the conversion efficiency decided by the two directions of polarisation.

In practice it is possible to achieve ratios of 500:1 with efficiencies of 90 per cent. It is essentially a small current device and presents a mainly capacitive load to the input and output.

Such a system offers many advantages to the electronic designer. There is no trouble with insulation as the ceramic possesses a high dielectric breakdown. The absence of a magnetic field, too, is an important factor in many instances. The "transformer" is light in weight and can be made in a very compact form.

Experimental units have already been built to supply 5 kV at 300 uA and many uses have been proposed. Obvious applications are for cathode ray tube high-voltage supplies; Geiger counter tube voltage sources; and as a source of high voltage for infra-red image converter cells.

FREQUENCY SELECTION

Since it operates at resonance, there are possibilities for the use of this type of transformer as a selective frequency device. Fundamental frequencies between 20 kcs and 100 kcs can be used, while mass loading enables units to be made for as low as 5 kcs. Using harmonics of the fundamental frequency, the upper limit can be extended without subsequent loss of efficiency.

Another version uses a ferrite magnetostriction unit as the driving half of the bar, enabling low impedance voltage sources to be used. Disc systems can also be built when the bar shape is unsuitable for certain installations. (From "Electronics Weekly.")

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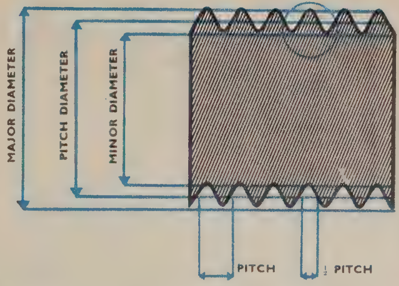
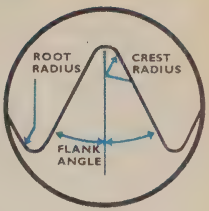
REVIEW — C.S.I.R.O. SCREW THREADS STANDARDS

Although virtually everybody uses machine screws in one form or another, not many people appreciate just how precise these threads need to be in many phases of industry. In order to assist Australian manufacturers to maintain the highest possible standards, the C.S.I.R.O. National Standards Laboratory provides calibrating facilities with extremely high orders of accuracy.





In the manufacture of a screw thread seven elements must be kept within specified limits.

Most of us think of screws only in terms of diameter and "threads per inch." These drawings show that there are no less than seven characteristics which must be checked to ensure that the thread is within specifications. In many applications they are all of vital importance.

A SCREW THREAD is by no means as simple as it seems. In its manufacture, there are seven basic elements to be controlled. These elements, shown in the diagram on the right, must be controlled to accuracies which vary considerably with the size, type of thread, and ultimate application. In many instances, variations of more than a few thousandths of an inch from the specified dimensions cannot be tolerated.

For production control, either fixed gauges or dial-type measuring devices are used. These must be accurate to a few ten-thousandths of an inch. The standards and equipment used for checking them must, therefore, be accurate to a few hundred-thousandths of an inch, and special techniques are necessary to deal with the difficulties of measurements at this level of accuracy.

The C.S.I.R.O. Division of Metrology, one of the three Divisions of the National Standards Laboratory, University Grounds, Sydney, provides a service to industry for the calibration of screw gauges and measuring equipment. To do this it maintains several specialised measuring machines, and various reference standards, with dimensions known to the required accuracy of a few hundred-thousandths of an inch or better.

To meet increasing demands from industry, which is itself progressively working to finer tolerances, the Division undertakes the development of equipment and techniques capable of achieving still greater precision.

THREAD FAILURES

The Division is called upon to investigate failures in threaded components and, in particular, to determine if these may have been caused by dimensional inaccuracies. Typical examples of components studied after failures are large coupling nuts on a marine diesel engine, and special threads on an aircraft propeller assembly.

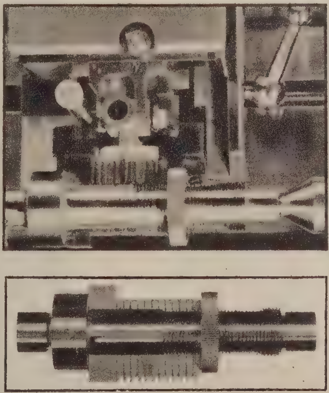
One type of screw thread of special importance is that used in the petroleum industry. To ensure the interchangeability throughout the world of certain components used in oil-well drilling and oil production, the American Petroleum Institute has evolved specifications for various taper screw threads. These are designed to operate under heavy loadings and, as high accuracy is required, very careful control is necessary during manufacture.

The product threads are checked with working gauges which are in turn checked against Reference master gauges. The Reference master gauges are checked against Regional master gauges, which are held in a few special laboratories, and are checked against Grand master gauges at the National Bureau of Standards, Washington.

The National Standards Laboratory, Sydney, is one of the laboratories approved by the American Petroleum Institute for this work, and holds sets of Regional master gauges for cable drilling and rotary tool joints. If oil is discovered in commercial quantities in Australia, the National Standards Laboratory will be able to provide adequate control for the important threaded components which will be required.

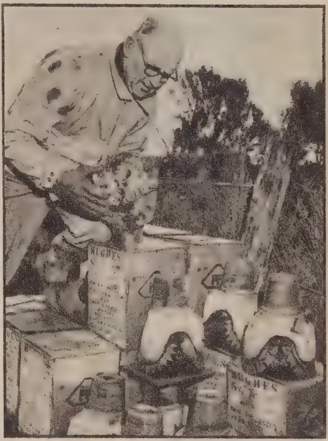
THREADS FOR MEASUREMENT

Screw threads often form important parts of machine tools or measuring machines. The accuracy of a lathe, for example, depends on the lead screw. Here it is the overall performance of the screw and nut assembly that must be checked, and the Division is continuing to develop techniques for doing this type of check.



The upper picture shows a screw thread pitch measuring machine in operation and (lower) an enlarged view of the reference standard. The latter is accurate to a few millionths of an inch.

An example of the precision equipment developed in the Division is a special set of slip gauges and carrier for calibrating, to a very high accuracy, any equipment used for the measurement of the pitch of screw gauges. This was exhibited at the recent Swiss National Fair at Lausanne. By a direct comparison with the lengths of light waves, each individual gauge can be measured to an accuracy of a few millionths of an inch.



Very special tapered threads are fitted to these "bits," used in oil drilling equipment. The C.S.I.R.O. has set of Regional master-gauges for such threads, issued by the National Bureau of Standards, Washington.

The surfaces of the gauges are highly finished so that, if placed together with a sliding motion, they will remain in close contact, and a number of these gauges can be "wrung" together without any significant loss of accuracy. When assembled and mounted in the pitch measuring machine, this special reference standard is thus accurate to a few millionths of an inch.

(C.S.I.R.O. Industrial Research).

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REVIEW—ELECTROMYOGRAPHY & MUSCLE ACTIVITY

Electromyography is an electronic method of measuring and recording the electrical activity of muscles. It is a valuable diagnostic tool in the hands of a competent operator. Most often used in physical medicine, neurology, orthopaedics and neuro-surgery, it has many applications in other fields, including research.

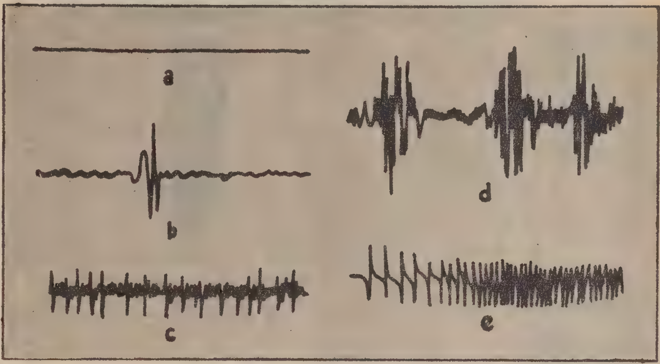

Fig. 1: Waveforms produced by various muscle activities. At (a) is a normal muscle at rest, (b) a normal muscle contracting, (c) muscle with nerve supply cut, (d) muscle with nerve regenerating, and (e) muscle disease (Myotonia).

THE high incidence of muscular and nervous-system injuries during World War II, and more recently during the Korean conflict, served to speed up the development of electromyographic techniques.

A normal muscle at rest emits no detectable electric signal (Fig. 1a) but in action or in certain abnormal states of the muscle (or of the nerve connected to it) waveforms are produced. The shape of these waves varies with the condition that causes them.

For instance, a normal muscle contraction will produce a tracing like that of Fig. 1b. The amplitude of the waveforms varies between approximately 100 and 1,500 uV, with a frequency of 5 to 30 per second or higher, depending on the intensity of the muscular contraction being measured. The average duration of the spike is about 5 to 10 milliseconds. The waveform is bi- or triphasic in character. Other characteristic waveshapes are also shown in Fig. 1. Most are abnormal and are found in disease states or injuries.

HYPODERMIC NEEDLES

The action potentials are picked up with a needle electrode which is pushed through the skin into the muscle being examined. Three types of needles are in use (Fig. 2). The first, a monopolar type, consists of a plain sewing needle passed through a cork and insulated completely except at its very tip. Such an electrode must be used with a reference electrode on the skin to complete the circuit. This reference electrode sets up numerous problems due to skin current and the distance between electrodes.

The second and third types are hypodermic needles fitted with either one or two wires through the needle bore and insulated from the needle shaft (and in the two-wire case, from each other). If one wire is used, it is called a single coaxial electrode. If two are used, it is referred to as a double coaxial electrode. Again the shaft of the needle is insulated except at its tip.

The advantage of the coaxial electrode is that it makes it possible to contact individual muscle fibres, since the tip of the needle electrode is a complete circuit unit only a fraction of a millimetre in size. This is approximately equal to the size of the individual muscle fibre or collection of fibres (known as a motor unit), which are controlled by only one nerve fibre.

When a double coaxial needle is used, the shaft of the needle is connected to ground, since the second wire inside the bore acts as the reference electrode. Ground electrodes are used to minimise the effect of stray pickup and interference.

The signals from the needle electrode are fed to the input grids of a preamplifier having a very high noise-rejection ratio, flat low-frequency response and high-frequency-cutoff circuitry. The preamplifier output is fed into a multistage differential amplifier with gain enough to produce an increase in signal strength of at least 100,000. The amplifier is designed to produce the absolute minimum of waveform distortion.

The output stage of this amplifier is coupled to the vertical amplifier of an oscilloscope and a tape recorder (for restudy when convenient). Pictures of the waveform may be taken later during the tape playback by arranging a triggering mechanism in the oscilloscope sweep circuit. This synchronises the opening of the camera shutter with the sweep. Note in the block diagram (Fig. 3) that a

(Continued on Page 111)

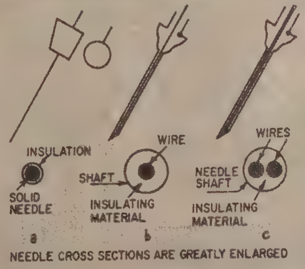

Fig. 2—Various needle electrodes and their cross-sections: a—monopolar (single wire) with reference electrode; b—single-wire coaxial (most commonly used); and c—two-wire coaxial.

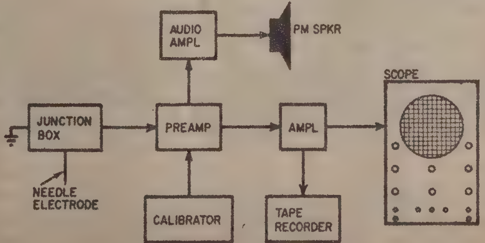

Fig. 3—Block diagram of an electromyograph.

Fig. 2: Details of the electrodes used in electromyography and (fig. 3) a block diagram of the amplifiers and display units. Note the audio amplifier and speaker, used for direct diagnosis.

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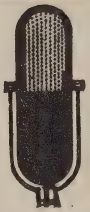

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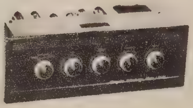

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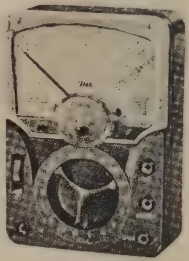

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SCIENTIFIC & INDUSTRIAL NEWS

HARDENING STEEL

SMALL amounts of alcohols and other organic materials added to water have the effect of diminishing the quenching rate of the resulting solution. This recently discovered fact is now being used to advantage during the heat-treatment of certain types of carbon and low-alloy steels.

Traditionally, the steel-using industries employ oil or water for the hardening of steels. Oil is used when a relatively slow quench is required and water or brine when a fast rate of cooling is necessary.

However, for many steels a water quench, though giving a fully hardened structure, would result in cracking and oil would make the same steel too soft for effective use.

Newly developed emulsions provide a quenching medium mid-way between that of water and oil.

[Croid Newark, Notts, England.]

LEVELLING SURFACES ELECTRONICALLY

A NEW electronic level indicator will register changes in level of less than one second of arc (five-millionths of an inch in an inch, or 0.005 mm. in a metre). The instrument can check for horizontal or vertical level.

The spirit bubble of conventional levelling devices is replaced by a pendulum co-operating with transducers which provides an electric displacement signal. This signal is fed to a centre-zero meter.

Consisting of a level unit which engages the surface under test and a battery operated, transistorised amplifier and meter unit with a switch to check battery voltage, the equipment gives level readings as gradients or angles. Three ranges of selectivity are provided.

[Taylor, Taylor & Hobson Division, Rank Precision Industries, Stoughton Street, Leicester.]

SILICON RECTIFIERS

ONE of Japan's major electrical manufacturers claims to have found a new and cheaper method of making silicon rectifiers, which cuts costs by about 15 per cent.

The new technique eliminates the need to use costly molybdenum or tungsten materials for certain types of silicon rectifiers, simplifies the manufacturing process, and substantially increases the performing efficiency of such rectifiers.

Hitherto it has been necessary to use a costly "buffer" material such as molybdenum or tungsten between the copper and silver element.

[Tokyo Shibaura Electric Company, Toshiba, Japan.]

STRONGER MAGNET

A STRONGER type of magnet has been obtained by sintering insulated magnetic flakes instead of the usual nickel-iron alloy powders.

The magnetic flakes, before pressing, align themselves along their magnetic lines of force. This means there are fewer air gaps in the compressed, finished component. This, in turn, can double the amount of magnetism carried by the pressing. The process is intended for medium and high frequency applications.

[Naval Ordnance Laboratory, Washington 25, D.C., U.S.A.]

THRESHING MACHINE

A NOVEL type of threshing machine, or combine harvester, weighs only two-thirds of a ton compared with the usual weight for such machines of about three tons.

The new machine depends on the fact that the grain is threshed against a rubber roller filled with air instead of the usual threshing board. While the grain is fed into the machine in the conventional manner, it is not loosened by means of a knocking process, but instead is rubbed free against the roller. After this rubbing process, the grain is fed through a cyclone unit, where the chaff and other unwanted matter are blown away.

[Developed by Norwegian Civil Engineer, Sigmund Stokland. To be produced by Globus Maskinfabrikk A/S, Brumunddal, Nr. Hamar, Norway.]

NEW ALLOY

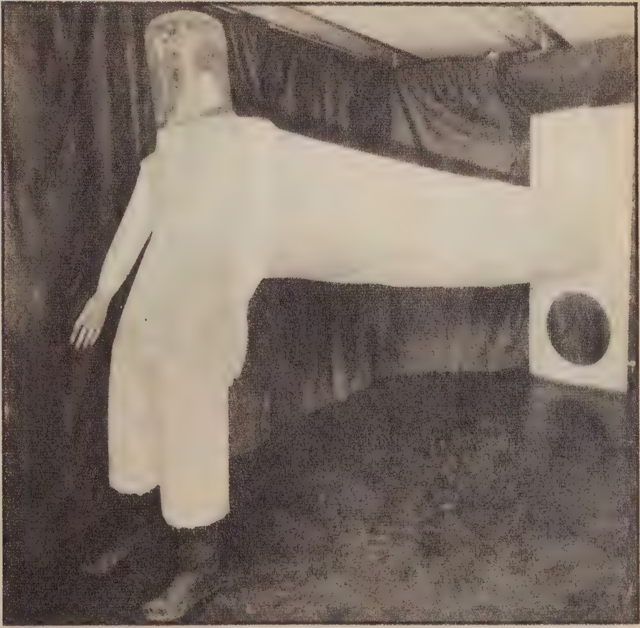
A new alloy used under conditions of extremely high irradiation is reported to improve its corrosion resistance because elements in the alloy are transmuted into others, giving a new mixture which stands corrosion better than the original.

The alloy is a silver-indium-cadmium combination which is used in control rods in nuclear reactors.

Under the radiation, the silver is partly converted into cadmium, the cadmium into indium and the indium into tin. This resulting alloy then shows the higher resistance to corrosion. For instance, an 81.5-13.6-4.9 alloy in use turns into 61.5-12.1-9.4 alloy with 2 per cent. tin. (The researchers are still looking for the missing 15 per cent.).

[General Nuclear Engineering Co., Windsor, Connecticut, U.S.A.]

A "NEW LOOK" PRESSURE SUIT



WHILE fairly obviously some kind of pressure suit, one might be pardoned for asking what kind of animal it is supposed to accommodate. It is, in fact, a new British radioactive decontamination suit, known as the NEWT. Purpose of the tubular section extending from the back is to provide an entrance tunnel through which the operator enters the suit feet first. Main advantage of the arrangement is that the suit may be entered without the need to remove it from the contaminated area, thus minimising the risk of spreading the contamination.

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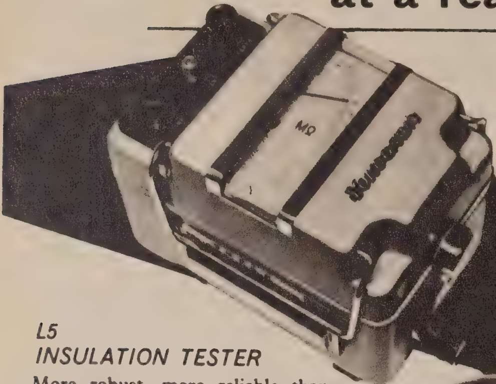

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ANTI-INFLUENZA DRUG

A NEW anti-influenza drug is thought to be first man-made anti-viral drug to be made commercially available. It is said to both reduce the length of the average influenza attack from six days to four days and to greatly reduce the susceptibility of people to 'flu.

The drug, which is taken in tablet form, is also said to be effective against mumps and measles, although not against poliomyelitis.

It was discovered at the Karbi Research Institute in Sweden by a team of research scientists working under Dr. B. Melander, and has been developed over a period of eight years.

Tests on its prophylactic ('flu prevention) capabilities carried out on a sample of over 2,000 people have shown that it reduced the incidence of influenza attack by 80 per cent.

The tablets which are based on the use of N-N-anhydrobis Hydroxyethyl biguanide are said to be very safe to use even in pregnancy. They do not kill the virus but affect the relationship between the virus and the cell. The dose ranges from one tablet three times a day for prophylaxis and two tablets three times a day in the case of an influenza attack.

NEW ALLOYS

NEW metal alloys which will stand temperatures of 1,450 degrees F. are now available experimentally. They are a by-product of a search by U.S. Government metallurgists for new types of electrical contact materials.

The new metals are gallium-copper and gallium-gold amalgams, essentially similar to the mercury-silver amalgam used by dentists for stopping teeth. The gallium alloys also have a small amount of tin added — 8 to 10 per cent. The solid metal is dissolved in the gallium which, like mercury, is liquid at room temperatures.

The alloy is then liquid but it begins to harden in about half an hour. In six hours it has obtained full hardness. The gallium-gold alloy is proof against 1,000 degrees F. temperatures and the copper alloy will stand up to 1,450 degrees F.

[National Bureau of Standards, Washington 25, D.C., U.S.A.]

PLASTIC NUTS

NEW plastic nuts are claimed to be cheaper than aluminium, partly because the bolt cuts some of its own thread in the plastic. The makers say the nuts are suitable for light metal assemblies such as toys, and costs only half as much as aluminium ones.

Screw threads are moulded in the top and bottom of the nuts when they are pressed, but the centre of the bore is left unthreaded. Since the bolt cuts its own thread through this section, the maker claims the nut holds better.

[Plastic: E. I. du Pont Co., Wilmington 98, Delaware, U.S.A.]

GAS DETECTION

ONE of the latest gas detection devices works by measuring the change in air density caused by the presence of foreign gases. It is intended for schools, factories, public buildings and other places where crowds congregate. Increasing use of odourless natural gas has increased danger, as was emphasised several years ago when a Texas school explosion killed many pupils.

The new alarm system compensates automatically for slow changes in air density caused by atmospheric conditions. However, a rapid change due to gas leak, whether heavier or lighter than air, closes an explosion-proof switch and sets off any type of alarm.

[Detectogas Instruments Inc., 3110 Eastside, Houston 6, Texas, U.S.A.]

AEROSOL FOODS

USE of a liquid gas rather than a compressed one in aerosol tins is expected to make it possible to sell butter, cream cheese and other products in this form.

Freon gas has been approved by American public health authorities as a propellant gas for aerosol foods. Previously compressed nitrous oxide was used. Addition of freon, which was developed for use in electric refrigerators, gives some foods slightly better texture and discharges them more uniformly.

[Du Pont de Nemours Co., Wilmington 98, Delaware, U.S.A.].

NEW MARINE PROPELLER

THE characteristics of screw and sculling propulsion have been incorporated in a novel marine propeller patented in America.

It is expected to be quieter than normal marine propellers — a quality sought after particularly by submarine designers looking for better methods of avoiding detection.

The new propeller is a flat disc of flexible material, turning in the same plane as a screw propeller would. Suction nozzles at opposite sides of the disc, one above and one below, deform it by passing it through a partial vacuum. This gives it a wave shape and this pushes against the water as it turns, thereby moving the craft forward.

[Dr. Peter Schlumbohn, 41 Murray Street, New York, N.Y., U.S.A].

POCKET DIRECTION FINDER

A NEW portable direction finder only the size of a small pocket book weighs just over 2lb and can be used either to give the user the direction of a single transmitter, or to obtain an exact fixing of his position by taking down the bearings of two radio stations.

The device can be used either with existing radio transmitters, or with special transmitters developed to give information for this purpose. The main body of the device is carried in the pocket or fastened to the belt of the wearer.

The main unit contains a ferrite aerial, or antenna, but an additional antenna for use where bearings must be taken over longer distances can be attached.

Readings from the unit are taken from a special instrument worn on the wrist. This shows the output, or relative field strength of the transmitter, while the direction from which the radio bearing is being received is determined by turning slowly in a circular fashion until the best response is received.

[Telefunken Gmbh, Sedanstrasse 3, Ulm/Donau, Germany.]

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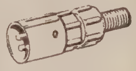

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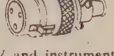

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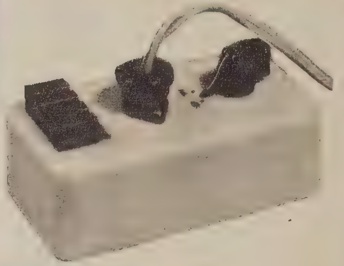
HIGH FIDELITY ON STEREO HEADPHONES

By the time this issue is on sale, an important new facility will be available to audio enthusiasts—the ability to listen to high fidelity stereo sound on headphones. Don't make the mistake of dismissing the idea lightly. In our opinion it is a most important development. The following article tells you why we think that way.

By Neville Williams and John Davidson



We can't take the credit for finding the model, but we did build the adaptor unit on the right, which enables the stereo headphones she's wearing to be used with almost any ordinary stereo amplifier system. The circuit and underneath photograph appear on the opposite page.

THERE is nothing new, of course, about listening to sound by headphones. Many of us heard our first radio programs that way and we thought it wonderful — until we began to learn a few home truths about frequency response and distortion level!

But give or take a few decibels and a few per cent, the frequency response and distortion characteristics of ordinary phones haven't altered very much since those early days. We've therefore been content to use phones only when we had to.

The idea of **high fidelity** headphones has had little substance, to date, for most enthusiasts. We've seen a few pairs of crystal phones, which lasted until moisture got at their elements, and still fewer "professional" types which generally cost somebody £30 or more.

HI-FI AND STEREO

It was not surprising, therefore, that we showed a good deal of interest when a pair of A.K.G. "high fidelity stereophonic" headphones arrived on the office table recently, with a price tag of 10 guineas retail.

Even this amount might sound a lot but it is not out of proportion to what audio enthusiasts pay every day for loudspeakers, enclosures, pickups, and amplifiers.

More to the point was the fact that the phones were credited with a response from 30 to 20,000 cps, were classified as 'high fidelity," represented locally by AWA and manufactured in the first instance by A.K.G. — one of the foremost manufacturers in Europe of high quality microphones.

A listening test with an audio generator soon confirmed the claim in regard to frequency response. There seemed to be some irregularity in the 6Kc region but there was equally no doubt as to the ability of the phones to pump the eardrums at 30 cps or to the limits of hearing at the other end.

What's more, the sound appeared to be clean at all the level one could possibly want.

So far, so good but what of the stereo facility?

Suiting the deed to the thought, we connected the phones to the output of our "Unit Playmaster No. 2," which happened to be set up at the time. That was when our interest really quickened.

"FANTASTIC"

There was no escaping it. What stereophonic reproduction can do for headphone listening is nothing short of fantastic. And this is NOT idle verbiage.

In short order, the phones were passed round to various members of our laboratory staff and everyone registered the same impression.

It was hard to believe that the loudspeaker system was not still in operation; that the room was not really filled with sound; that other people standing round and chatting were not really miming a conversation against an impossible acoustic deluge.

Of the subjective reactions to stereo headphone listening more is said in "Off The Record" elsewhere in the issue. It is sufficient to repeat here that the quality of sound and the pleasure of listening bears direct comparison with that afforded by a good quality stereo loudspeaker system.

It is not in any sense a poor substitute for the real thing.

To audio enthusiasts generally, this can be vitally important. If casual conversations mean anything, it is no exaggeration to suggest that domestic hi-fi systems at present have to remain idle half the time, because members of the household want to study or read or watch television—or just plain sleep!

The would-be record listener has to mope around meanwhile and lament the music that might have been. Hi-fi earphones, particularly when fed with stereo signals, can provide an answer to this dilemma and make everybody happy!

In reverse, it might easily be that junior can listen to his rock-and-roll without driving everyone else in the house to distraction.

Technically the A.K.G. headphones are listed as having an impedance of 400 ohms per phone and requiring a power input for normal listening of 1 milliwatt.

MAXIMUM SIGNAL

To verify this latter figure, we connected a calibrated C.R.O. across the leads and invited members of our staff to set the level to suit themselves. It transpired that no one wanted more than 1 volt R.M.S. maximum signal across the phones, even when a radio was turned on nearby to simulate posible noisy conditions in a home.

This figure is important because it means that ample voltage to operate the phones will be available across the secondary of the output transformers in any likely domestic stereo system, even one using single pentodes operating into 2-ohm voice coils.

Our first step, therefore, was to build up the simple unit pictured at the head of the article, to permit the phones to be connected easily into the speaker lines of an ordinary stereo amplifier system.

As will be apparent from the circuit, the unit is a very simple affair, involving a double-pole double-throw rotary switch, two wire-wound resistors, plus suitable connectors. It should be mounted in a convenient spot near the amplifier and wired into the loudspeaker leads.

In one position of the switch, the headphones are isolated and the amplifiers connected straight through to their respective loudspeakers.

With the switch in the second position, the loudspeakers are shorted out and the amplifiers fed into a couple of wire-wound resistors, which should be equal in value to the nominal resistance of the loudspeaker voice coils in use.

The headphones are connected in parallel with the two resistors — one phone across each.

Because the phones will not normally need to be fed with more than 1 volt R.M.S. of signal, the amplifiers will not normally be required to operate at a level greater than about one-half watt, even on the loudest passages. Therefore, 3-watt resistors should have an ample margin of rating.

SPEAKER OR PHONES

The unit, as suggested, simply provides for alternative phone or loudspeaker listening, this being the normal requirement.

The phones could conceivably be used as a hearing-aid system in parallel with the speakers but difficulties may occur in matching the required levels. Again, people needing hearing aids often suffer notable differences between their ears, which could lead to difficulties in setting the Balance control.

All this would best be regarded as a separate and rather special problem.

The construction of the unit is simplicity itself. There is no special need to follow our exact lead, though most will find it convenient to do so.

We assembled the components into a small bakelite box, measuring 4¾ x 2¾ x 1½ins overall. This same box has been used from time to time for other small gadgets. Distributed in the first instance by Messrs Watkins Wynne, of North Sydney, it is available through many radio dealers.

From one end of the box, two pairs of leads, using plastic lamp cord, run to the amplifier voice coil output terminals. The existing loudspeaker leads run to the connectors at the other end of the box.

Connections to the switch, plug and resistors are sufficiently obvious as not to require lengthy comment. Note that the switch in our unit is a four-pole type, with some of the connections unused. A similar two-pole type is available.

TOGGLE SWITCH

A DPDT toggle switch could be used equally well, if one happens to be on hand.

When installing the unit, care is necessary to ensure that correct phasing is obtained for both loudspeakers and headphones.

We suggest that the unit be installed and the loudspeakers phased first of all by the methods suggested on page 96 of our June 1960 issue. Mark the leads and connections for future reference with suitable dots of coloured lacquer, or by any other method you may happen to prefer.

While so doing, mark which of each pair of speaker leads is the earthy one. You can either trace them out or short each wire in turn to the amplifier chassis. The leads which cut out individual speakers, when shorted to chassis, will obviously be the active ones. The others will be the earthy leads.

The headphones must also be suitably phased and this can be arranged by the method in which the leads are wired into the plug.

The leads, as supplied with the phones, look rather like a length of twin plastic lamp cord but, each section actually contains an inner conductor and a shield braid. The chances are that correct phasing will be obtained when the two outer braids are connected to the earth sides of the speaker lines, which you have previously marked.

This will not always be so, however, particularly with amplifiers having a phase-reversing switch in one output circuit.

There are two ways of establishing phasing of the headphones, both carried out with amplifier system switched to Mono.

The first is very simple when a phase reversing switch is available on the amplifier. Hold the headphones, with their faces very close together but leaving a very narrow V-slot, with the open end towards you. Turn up the volume till you can just hear the sound, then click the phase rotating switch back and forth.

The headphones will be in phase in the switch position which gives the greater sound output. There is not a great deal of difference but it can be heard.

Having established the two conditions, one set of leads can be wired into the plug in such a way that speakers and phones are alike in phase when the switch is in a given position. Care is necessary in wiring the plug, by the way, because the leads are very fine and could easily be shorted, or shorted across, or broken.

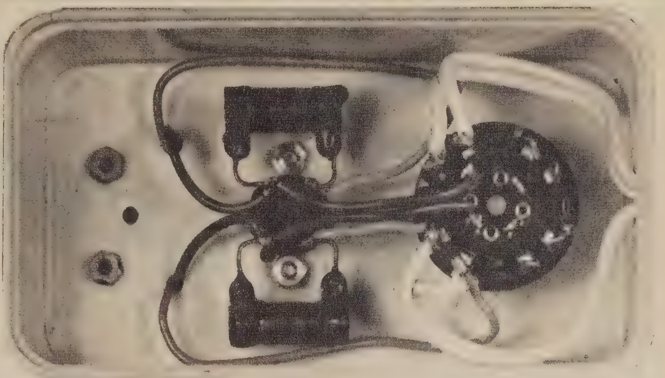
LISTENING TEST

The second method of phasing is to put the phones on and set the volume at normal listening level. When the phones are in phase, the sound with the amplifier switched to mono will appear to be concentrated in the centre of the head and will move from one side to the other as the Balance control is altered.

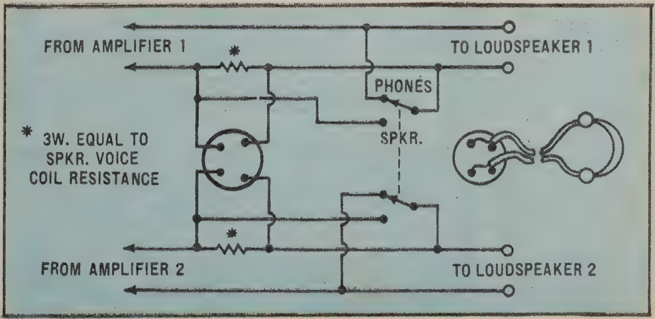
With the phones out of phase, the sound appears to be reaching each ear separately and it is NOT concentrated in an apparent source within the head.

The foregoing remarks assume that the in-phase condition produces cycles of pressure and rarefaction simultaneously on the two ear drums. This would be

WIRING OF HEADPHONE ADAPTOR



There is very little wiring underneath the headphone adaptor but it is well worth building up. The switch pictured is a four-pole type but not all contacts are used. Two-pole switches of the same style are readily available.



The headphone adaptor directs the output from the amplifier either to the speakers, as normal, or to load resistors across which the phones are connected. The resistors should have the same value as the nominal impedance of the loudspeaker voice coils.

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the case for normal listening, at least for low frequencies.

When suitably phased using a mono signal, the set-up should be optimum for stereo listening. As to the difference between mono and stereo listening, we leave you to judge.

One point we would emphasise, however. You are feeding energy into a pair of headphones—not into a couple of husky 20-watt speakers. While we have no reason to believe that the headphones are especially delicate, they should be treated with discretion. Therefore, until you are sure of your levels, make a practice of retarding the gain setting before switching to phones, and operate them only at proper listening level.

So much for those who have an existing amplifier system.

The availability of wide-range stereo headphones raises the possibility of using them for ALL listening, completely doing without loudspeakers. While this may sound a rather crazy notion, at first mention, it will be anything but crazy to audio enthusiasts in flats, boarding houses or private homes where circumstances just don't permit of listening at reasonable loudspeaker volume.

STEREO HEADPHONE AMPLIFIER

Using the smallest available power transformer, two twin-triodes and a rectifier, this little unit accepts the input from a stereo crystal pickup and drives the stereo headphones at ample level, while providing normal volume and balance facilities.

AMPLE VOLUME

With headphones, you can have all the volume your ears can stand, without anyone else being aware of it.

Certainly, headphone listening in such circumstances is gaining popularity overseas.

In such case, there is obviously no point in providing two large, complete power amplifiers, just to have their energy dissipated in a couple of load resistors. It is entirely possible to construct a much cheaper and simpler unit, designed only to feed the headphones.

One proposition, which has been mentioned frequently of late in overseas literature is that of feeding the phones directly from the output of a normal Control Unit, such as might be used later to feed into a regular amplifier system.

While intriguing at first glance, several difficulties are likely to occur. The first and obvious one is that few Control Units have their own in-built power supply. Therefore, an auxiliary power supply must be provided.

Secondly, many Control Units have relatively high impedance output circuits, intended to operate through a short length of coaxial cable into the first grid of the main amplifier. Either they will not have enough power output to operate the relatively low impedance phones or, even if they do, the low output loading may interfere with internal compensating or coupling system, thereby deteriorating the frequency response.

The result may be high distortion on peaks and/or poor frequency balance.

A still further problem is that the phones require an RMS signal voltage on loud passages of about 1 volt, whereas the gain of many Control Units is manipulated on the assumption that only about one-quarter volt will be needed by a following amplifier.

Thus, even assuming that the Control Unit could deliver the requisite power, there is an even chance that it will be lacking in effective gain, if required to feed into headphones.

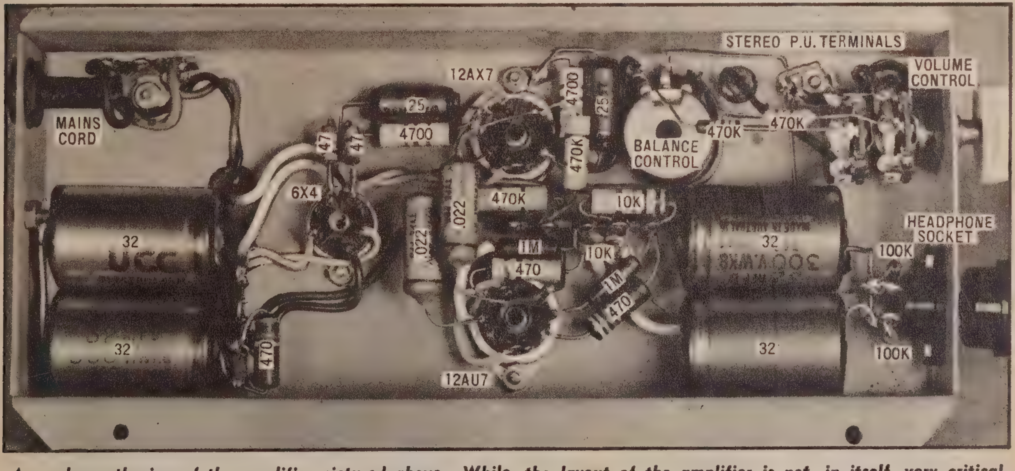
Our advice, which will hold good for many commercial Control Units and certainly for all R, TV and H designs, is that no attempt be made to operate directly into phones. Rather, that a small twin-channel amplifier be added, along with the power supply, to provide enough extra gain and output power to operate the phones, while simultaneously allowing the Control Unit to work under normal conditions.

ACTUAL UNIT

In fact, we have gone one better. We have designed and built such a unit which, with slight modifications, can be used in two ways:

(1) With any ordinary Control Unit, operating from a crystal or magnetic pickup, as intended.

(2) Operating directly from a stereo



An underneath view of the amplifier pictured above. While the layout of the amplifier is not, in itself, very critical, this detailed photograph should enable you, if you wish, to duplicate the original unit.

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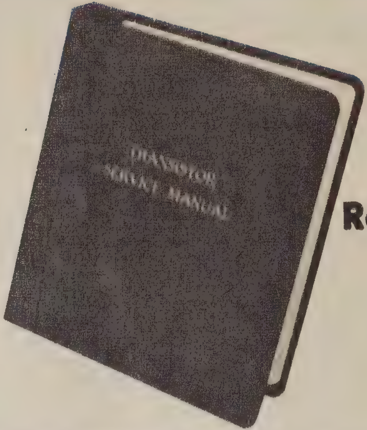

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crystal pickup as a completely self-contained amplifier.

In the first role, the unit needs no controls of its own and is simply provided with heater, earth, high tension and audio leads, wired to a plug or socket to suit the particular Control Unit.

In the second role, the connecting leads are replaced by an input volume control and a balance control, to make the unit self-contained.

The coded photograph on the previous page and the circuit on the right show the unit in this second role.

To obviate the necessity for output transformers, we used the two sections of a 12AU7, one in each channel, as cathode follower output stages. These feed the phones through electrolytic capacitors, which serve to isolate the DC from the windings.

ADEQUATE POWER

The power available from the valves is not high under those conditions, but it is sufficient for the purpose.

Because of the very low gain of the cathode follower connection, high gain is necessary ahead of the 12AU7 to ensure satisfactory operation from all types of stereo crystal cartridge. Hence the use of a 12AX7 in the preliminary stages of each channel, used under its highest gain conditions.

We had no trouble, with this arrangement, to load the headphones fully, using a crystal cartridge with rather low output. Though we did not actually try one, it is almost certain that the gain would also be adequate for the ceramic cartridges which are currently receiving attention.

The power supply consists of a 6X4 rectifier and a power transformer with high-tension secondary rating of 150 volts per side at 30 milliamps. Filtering is provided by two 32mfd. electrolytic capacitors and a 470-ohm 1-watt resistor.

This supply is adequate to operate a Playmaster Control Unit, as well as the basic headphone amplifier, the additional components necessary being mentioned later in the text.

The unit, as pictured, was built on a chassis measuring 9 x 3½ x 1½in deep, with ½in flanges along both sides. Construction should commence by mounting the major components, and the reproduced photograph will be of assistance in this regard.

From the under-chassis view it is evident that there is adequate space for all of the minor components.

MINOR COMPONENTS

Tag-strips are used to support some of the wiring components, while others are suspended between the tag strip and the appropriate valve socket pins. The incoming AC mains lead is terminated on a three-lug tag-strip mounted below the power transformer. The earthed centre lug of this strip provides a convenient anchoring point for the mains earth.

To the right of the filter capacitors is the four-pin tag-strip on which are anchored the filter components. The top lug of this strip is not used when constructed as a self-contained unit and a three-lug strip would suffice in this case.

The third tag-strip shown in the photograph is a five lug type, of which only four lugs are actually used; it is mounted between the two 9-pin sockets. The first lug is used as an HT distribution point, the second and fourth lugs for the cathode follower output components, including the two 32 mfd coupling capacitors. Lug three provides a convenient earth point.

Both the 12AX7 and the 12AU7 sockets are orientated with the key towards the balance control side of the chassis. Pins 1, 2, 3 and 6, 7, 8 of each valve are used for channels one and two respectively.

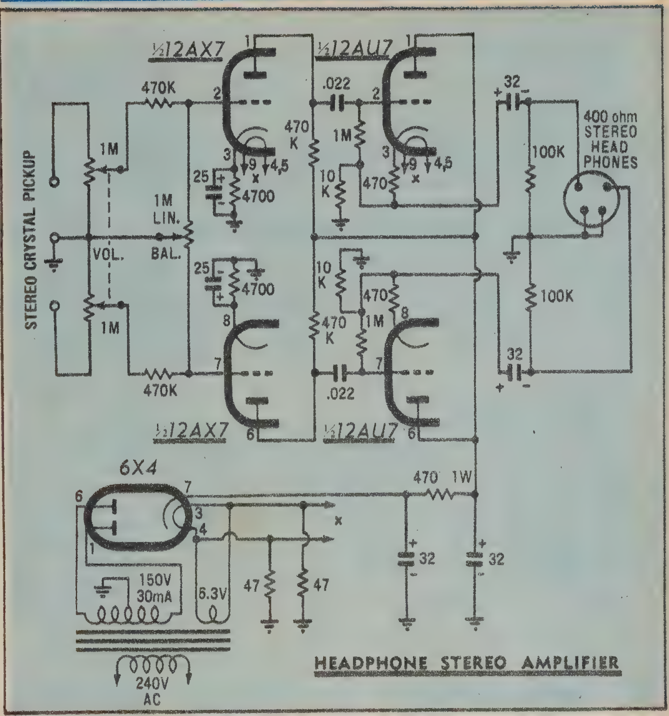
The ganged volume control and the stereo crystal pick-up terminals can be seen to the right of the balance control. Below the volume control can be seen the four-pin plug and socket for the high fidelity stereo headphones. This socket provides a suitable anchor point for the negative ends of the 32 mfd capacitors and the 100K resistors.

So much for the unit as a self-contained amplifier.

MODIFICATIONS

The supplementary diagram below indicates the modifications, which have to be made to the above circuit, to make the unit suitable for use with a normal Control Unit. The volume and balance controls, and the input terminals are omitted, leaving space for an eight-lug tagstrip, on which to anchor the leads for connection to the Control Unit.

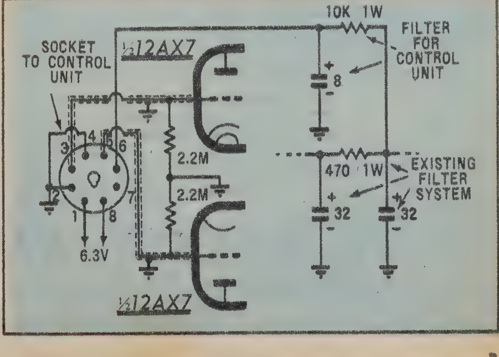
AMPLIFIER CIRCUIT DETAILS



Here is the circuit of a completely self-contained stereo amplifier, designed to feed hi-fi stereo headphones, when operating from a crystal pick-up. By making the modifications shown below, the circuit can be arranged to operate from — and supply — a normal type of Control Unit.

☆

Using a circuit such as shown above in conjunction with a Control Unit involves replacing the input potentiometer system with a cable or socket wired to suit the Control Unit. Additional power supply decoupling may also be necessary, the 10K resistor and 8 mfd capacitor being typical.



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The first lug on this strip connects to pin 2 of the 12AX7, the second is earthed, while the third lug connects to pin 7 of the 12AX7. This arrangement provides a convenient mounting position for the 2 megohm grid input resistors.

The fourth lug is for HT and the fifth and sixth lugs for the 6.3v heater supply.

As shown in the supplementary circuit, an 8mfd electrolytic capacitor and 10K ohm resistor are added to the power supply filter to provide HT decoupling for the Control Unit. The extra capacitor is located between the existing filter capacitors and the mains input strip, making use of the fourth lug on the supply filter tag-strip to anchor the capacitor and the 10K resistor.

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Here's your answer, Tom!

Here is the sixth article in the current series devoted to the principles of electronic measuring instruments. This month we conclude the discussion of the electronic voltmeter with an explanation of the amplifier-type and automatic VTVMs.

By Jamieson Rowe

THE automatic voltmeter, also known as the "automatic digital voltmeter," is really another form of the familiar balanced-bridge VTVM which we have been discussing. It is thus probably the most convenient one with which to commence this month's discussion.

The automatic voltmeter is basically a balanced-bridge voltmeter, but the application of a special system of mechanical feedback transforms the circuit into a servomechanism of the "self-balancing bridge" type. Figure 1 shows the bare essentials for such a unit.

As before, we have two triode valves, and the circuit looks vaguely like the balanced - bridge circuit, with a zero-set potentiometer between the plates and HT. However, the two cathode resistors have disappeared, and in their place we have the two halves of a centre-tapped field coil winding on a small DC motor.

A motor of this type, when connected as in this circuit, will rotate in a direction governed by the difference in the currents flowing in the two halves of its field winding. It is thus spoken of as having a "differential field."

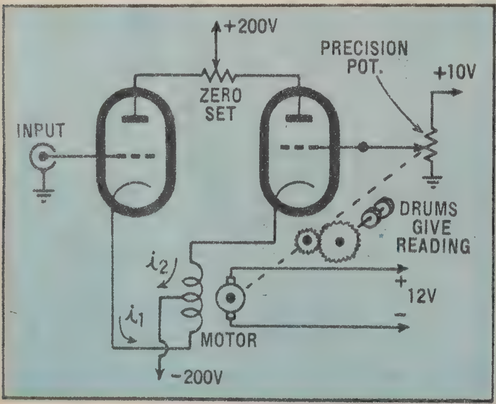

Fig. 1. The automatic digital voltmeter utilises the principle of the self - balancing bridge.

An examination of the circuit will show why this occurs. The currents flowing in the two halves of the field winding produce magnetic fields in the motor in opposite directions, and thus tend to cancel out each other. The actual magnetic field operative in the motor will be equal to that produced by the **difference** in the two currents (i.e., i1-i2), having a direction depending on whether i1 or i2 is the larger current.

If the two currents are equal, for instance, the magnetic field produced by each will cancel that produced by the other, and the resultant field will be zero. The motor cannot rotate, since there is no magnetic field to interact with the current-carrying conductors of the armature. It is this fact which allows us to use the circuit as a measuring bridge, a null or balance being registered when the motor ceases to rotate.

As before, any difference in the currents drawn by the two triode valves will unbalance the bridge, and the motor will run. And herein lies the big feature of this circuit—it can balance itself!

The balancing function depends on the precision potentiometer placed in the grid circuit of the second valve, and its coupling to the shaft (via gearing) of the motor. This constitutes the mechanical feedback mentioned a while ago.

To examine its operation a little more closely, first visualise the circuit if the input grid is shorted to earth. The only way for the bridge to be balanced under these conditions is for the second grid also to be at earth potential. This is controlled by the pot, which is in turn under the control of the motor.

Because of the initial unbalance in the differential field winding, the motor will run until the moving arm of the pot is at earth potential, when it will stop. The bridge will thus have automatically balanced itself.

If the input grid is applied to a point which is 3 volts positive with respect to earth, the motor will run until the moving arm of the pot is also at plus 3 volts, and again stop.

In other words, the circuit will always match the input voltage with an equal voltage from the pot. If it can, that is.

Obviously enough, this simple circuit cannot automatically balance the input voltage if it is greater than 10 volts, or if it is negative. To do this, various additional circuits must be added.

To adapt the circuit for the measurement of higher voltages, for instance, a voltage divider similar to that used with the normal balanced-bridge circuit is used. It, too, can be made automatic, by using a number of relay circuits biased to operate at various input levels.

POPULARITY REVERSAL

Again, automatic reversal of polarity, to adapt the circuit for negative input voltages, can be achieved by suitable sensing and relay circuitry.

It is apparent that, when this circuit finally comes to rest in its balance position, the position of the pot shaft is governed by the size of the input voltage. For every input voltage, there is a unique position of the shaft. To register the size of the unknown voltage, all we have to do is attach an indicator to this shaft.

The indicator may be in the form of a number of geared drums, having numbers around their periphery and placed behind a viewing window (see Figure 1) or a rotary switch operating a numerical indicator glow tube. Or again, the switch could be used to operate lamps illuminating translucent numbers.

Whichever way it is used, the input voltage is indicated automatically as an actual number of volts. If automatic range changing is incorporated, the range may be indicated merely by small neon bulbs used as decimal points. Another neon indicator may be used to indicate the input voltage polarity.

BECOMES COMPLEX

By the time all this is translated into a practical instrument, it becomes very complex and expensive. But it is also very convenient to use. Instead of having to set range switches and read a finely graduated meter scale, it is merely necessary to touch the prod on to the point to be checked. The number of volts and the polarity are registered directly in the indicating spaces.

Incidentally, this same basic circuit is the one used in another automatic measuring instrument, the recording voltmeter. This instrument is exactly the same apart from the indicating device.

Instead of dials attached to the motor-pot shaft, a linkage which moves an ink pen across a roll of recording graph paper is used. The paper is driven past the pen by a clock or motor mechanism and the pen traces out a graph of the input voltage.

As you may have guessed, the general principle of the self-balancing bridge circuit as used in these instrument is the one responsible for many devices of the automatic control and servomechanism variety. Automatic controls of temperature for boilers, automatic exposure setting for cameras and automatic speed control of motors are just a few applications. Many other modern devices, having self-adjusting properties, use this basic principle.

AMPLIFIER TYPE

There is one major type of electronic voltmeter which we have not discussed yet, Tom, namely the amplifier type. This is generally used for the measurement of alternating voltages only.

As we saw in the fourth article of this series, a triode valve (or other valves, having more grids) can be used to amplify alternating voltages. A small alternating voltage applied to the grid causes a substantial variation in the plate current; this can cause an alternating voltage to appear across a resistor placed as a load in the plate circuit.

By suitable choice of the plate resistor, the valve and its operating conditions, the voltage developed across the plate resistor can be considerably larger than the input grid voltage; the valve is then said to provide a voltage gain. It also has a power gain, because the grid, drawing no current from the source, uses no power, whereas the plate resistor has considerable current flowing through it.

The question thus arises—"why not use one or more valves to amplify small alternating voltages, then rectify the result and apply it to a normal moving coil meter?"

Well, that is exactly what is done in the amplifier-type VTVM. Figure 2 shows the basic circuit for a meter of this type. This circuit uses three amplifier stages, but any reasonable number are possible.

BLOCKS THE DC

The input voltage is fed through a capacitor C (which, you will recall, prevents DC flowing while effectively conducting AC) to the grid of the first valve. The capacitor C, therefore, stops the circuit under test from affecting the valve's grid bias, or vice versa.

The amplified input voltage developed across the first plate resistor R1 is then passed to the grid of the second valve by the coupling capacitor C1, which blocks DC as before. The signal undergoes further amplification in the second valve. The amplified output, appearing across R2, is passed again to the grid of another valve.

The plate resistor of this third valve is adjustable, allowing the amount of voltage gain of the stage to be adjusted. With R3 low, for instance, the gain is low; if R3 is increased in value, the gain also increases. This enables the gain of the complete amplifier to be adjusted to a convenient round figure.

The output from the third valve is applied, via a coupling capacitor, to a system of four diodes connecting to a moving-coil meter. The diodes are arranged in what is called a "full-wave bridge" circuit, which rectifies the alternating voltage, so that it can operate the DC meter.

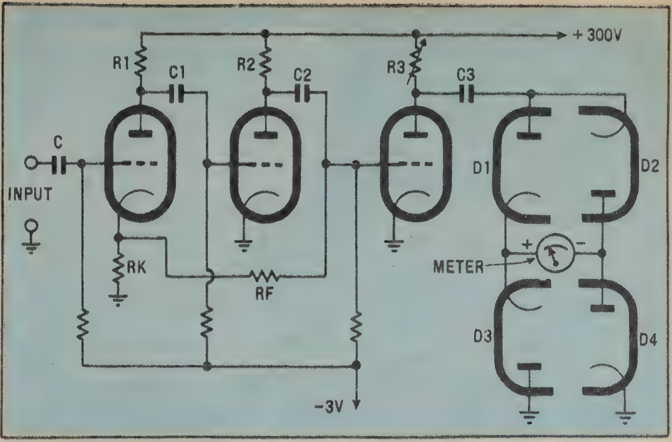

Fig. 2. Here we see the basic circuit for a typical amplifier-type AC electronic voltmeter. Sensitivities of 1 millivolt full scale are possible with this type of instrument.

You can visualise the action of the bridge circuit this way: During the positive half-cycles of the signal, the meter conducts through diodes D1 and D4, the other two being effectively open circuit. During the negative half-cycles, conduction is through diodes D2 and D3.

You will notice that the circuit is arranged so that current always flows through the meter in the same direction. The circuit shows thermionic diodes in the bridge rectifier, but equally suitable are semi-conductor diodes of the silicon or germanium types. These diodes are normally used in practice, as they require no cathode heating power.

TWO COMPONENTS

There are two components in this circuit as yet unexplained: Rf and Rk. These provide what is called negative feedback, which improves the gain stability of the amplifier considerably, a feature most desirable in a meter of this type.

As you can see, it amounts to a voltage divider across the output of the second stage, feeding a portion of its output voltage back to the cathode of the first valve. The reason for the name "feedback" is thus apparent; but the "negative" part may not be appreciated. This is used because the voltage fed back is opposite in phase to the input voltage, due to the fact that an even number of valves (2, 4, 6 . . .) produces an output which is out of phase with the input, when fed back to a cathode.

By opposite in phase, we mean that when the input is positive, the output is negative, and vice-versa.

The fed-back voltage thus tends to cancel out the input voltage, effectively reducing the gain of the first two stages. But it also improves the frequency response and gain stability if carefully designed, so it is desirable in the circuit.

Well, Tom, that ends the discussion on electronic voltmeters. Next month we will discuss the applications of the AC bridge circuit, particularly those concerned with the measurement of resistance and capacitance.

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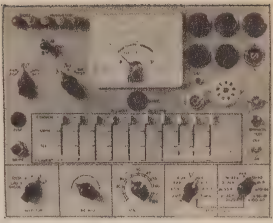

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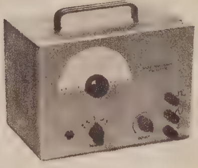

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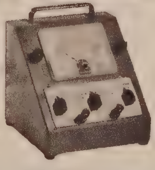

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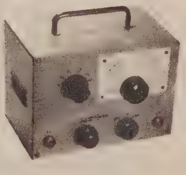

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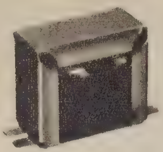

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FROM THE SERVICEMAN WHO TELLS

One effect of the advent of TV has been to convince many servicemen that, once they have mastered the art of servicing TV sets, the humble radio set may henceforth be regarded as child's play. Don't you believe it. A set I received for repair this month served to convince me once again that not all tricky faults occur in TV receivers.

THE set in question was a conventional 5-valve superheterodyne, which had for some time suffered from intermittent operation, and had finally quit altogether. Nothing unusual so far; in fact this is the condition in which I would prefer all my intermittent receivers to arrive.

Shifting the set to the service bench I started by checking the audio end. A screwdriver applied to the grid of the 6B8G audio valve resulted in a very healthy "burp" from the speaker, so all was in order there.

Checking the voltages present throughout the receiver showed nothing out of place, although the HT was about 50 volts low. Replacement of the rectifier valve cured this, but, in any case, this would not have been sufficient to "kill" the receiver.

VALVE CHECK

Replacing the 6SK7 IF amplifier valve and 6J8G converter valve produced negative results. At this stage I was not unduly perturbed, because even though it was a fairly simple receiver, there were still quite a few components which could cause a failure of this nature.

Next in line was a check of the IF stages for gain. Applying a signal generator tuned to 455KC to the grid of the 6SK7 produced a healthy, 400 cps note in the speaker, and proved the second IF transformer and 6SK7 valve were functioning correctly.

The output from the signal generator was now applied to the grid of the 6J8G mixer valve and this time produced a loud silence!

Since I had previously tried a new valve in place of this one, and all voltages were correct, it left only the first IF transformer as my prime suspect.

Switching off the power, I proceeded to check the continuity of the transformer windings with the bench meter. Both windings appeared to be in order, and I could find no evidence of a short to ground; why, then, didn't some of the signal pass through this transformer?

SHORTED TURNS

Even supposing some of the turns to be shorted, causing mistuning, the amount of signal which I had applied to the 6J8G grid should have produced something, be it only a whisper of sound.

(At this stage I was tempted to put the set aside and go on with a TV set having an intermittent fault in the sync separator stage, which had been on the bench all morning!).

However, I once again plugged the set into the mains, and even though I could see no obvious dry joints, proceeded to do a little probing with a piece of ¼in ebonite rod.

The signal generator was still pumping a hefty signal into the grid of the 6J8G, and, when the grid connection of the first IF transformer was moved, the set burst into life. Re-soldering both ends of this lead failed to cure the fault so it was obvious that something was amiss inside the transformer itself.

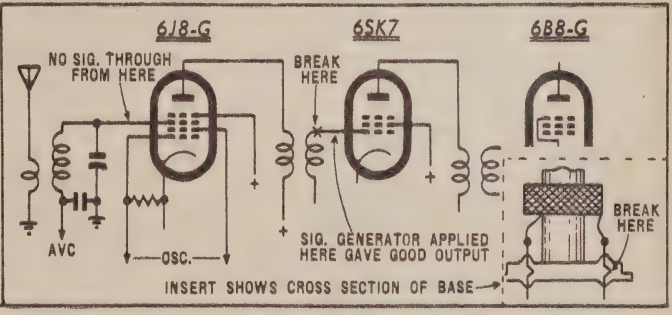
Removing the offending component from the set and subjecting it to a visual inspection did not at first reveal the cause of the trouble, and it was not until I interposed the transformer between the bench light and my eyes that the trouble was revealed.

PLASTIC BASE

This particular transformer was of a brand popular some years ago, and featured a translucent plastic base through which the connecting leads of 18swg tinned copper wire were passed.

To prevent the lead pulling loose in the base during soldering, each lead had a V-shape crimp in it, which was moulded inside the plastic base.

The lead on the grid pin, however, had apparently been subjected to a severe strain during this crimping process, and a break was clearly visible at the bottom of the V.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AVC
OSC.
SIG. GENERATOR APPLIED HERE GAVE GOOD OUTPUT
BREAK HERE
INSERT SHOWS CROSS SECTION OF BASE

Circuit of the relevant portion of the receiver showing the position of the break. Sensitivity was normal from the grid of the 6SK7 but poor from points further forward. Insert shows the type of lug and position of the break in the base of the plastic former.

When I had placed my meter probes on the pins in order to read continuity, the broken ends had been pressed together, leading me to the erroneous conclusion that all was in order.

As I said at the beginning, not all of the tricky ones are to be found in the complicated circuitry of TV sets and the like!

Another rather unusual call I received during the month came early one morning, following a severe thunderstorm the night before. The caller was obviously a very worried man. "My TV set was struck by lightning last night," he almost blurted out. "I don't know how much damage has been done, but I wish you'd come round and have a look at it as soon as possible."

As I say, he sounded a very worried man, and I must confess that I was a little worried myself. The chances of lightning striking any particular object may be only one in several million, but when it does strike it doesn't usually "muck about." Most country people have seen massive trees split from top to bottom in a flash, while power and telephone mechanics can tell some grim stories of equipment reduced to charred wreckage, when their lines fall victim to this impressive force.

(It is sometimes remarked that lightning never strikes twice in the same place. "That," claims one of my colleagues, "is only because, after it strikes the first time, the same place isn't there any more!")

Thus it was that I began conjuring up visions of a complete TV chassis reduced to a charred mess, fit only for the garbage can. Frankly, I didn't relish the prospect of breaking such grim news to the owner.

When I finally reached his home, and before actually tackling the set, I made a few inquiries as to exactly what had happened. After all, it wouldn't be the first time an anxious owner had mistaken a power failure or transmitter failure for a fault in his own set.

GENUINE FAULT

But it seemed that it was neither of these. The family had been sitting comfortably in the lounge room, enjoying the program while the storm raged outside, when there was a sudden flash of lightning and simultaneous clap of thunder that made everyone jump. At the same instant the picture flickered, seemed to hold for a second or so, then vanished completely.

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PTY. LTD.

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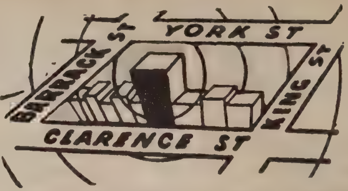

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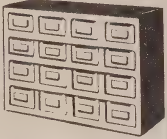

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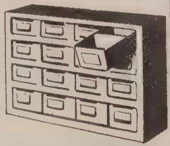

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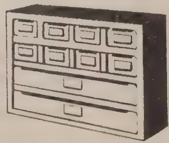

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And, to cap it all, a flickering glow could still be seen through the translucent picture tube mask, as though something was on fire in the chassis proper. The owner quickly pulled the plug out of the power point, probably with the idea of taking the chassis out of the cabinet if this was not effective. However, the "flames" had vanished and no further action was necessary.

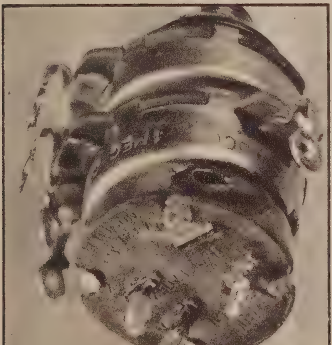
By the time the owner had told me all this I had the back off the cabinet and was sliding the chassis clear. As I turned it over, I was relieved to see that, whatever the damage was, it certainly wasn't in the "complete write off" category. In fact, as far as I could see, there was no obvious damage.

However, a closer look showed what had happened. The victim was the switch section of the combined "volume, brightness, on-off" control. As can be seen in the accompanying picture, one part of the switch cover was badly blackened, a fair size hole had been punched in it, and one of the lugs on the back of the switch—adjacent to the blackened area—was missing altogether.

MOLTEN LUG

This latter was found several inches away, dangling on the end of the 240V lead, and a close examination showed that the end which normally fitted inside was just a molten blob. As a matter of interest, I prised off the insulating disc forming the back of the switch and had a look at the "innards." It was in a proper mess. Everything was covered with a layer of black soot and most of the metal parts were floating around loose, many of them also just blobs.

Quite obviously, the whole unit was a complete write-off, but it made repairs comparatively simple. I happened to have a suitable replacement pot in the truck, and fitting this in place of the damaged one was quite straightforward. Thus, some little time later, I was able to switch the set on and demonstrate to the owner that it had not suffered any serious damage. He was obviously quite relieved.



"On-off" switch wrecked by a lightning surge on the power mains. The hole punched in the case is clearly visible, while the molten terminal lug is shown as a separate item in front of the switch.

FELLOW SERVICEMAN COMMENTS

Dear Sir,

You seem to be a trifle self-conscious about relating instances involving your own equipment. Let me hasten to assure you that there is no need to be that way at all and, in fact, one of your recent stories did me a lot of good.

When I read your story about fixing your oscilloscope I was conscience stricken about my own bench multimeter. This is the one that I use from day to day, although I have an Avometer which I can use when higher accuracy is required. But I do not like leaving the Avometer around the bench all day where it can be spattered with solder or scratched or even bashed by something falling on it.

The bench multimeter was one I built years ago to a "R, TV & H" design and, while it has given good service, I was conscious that some of the ranges had shifted a bit during the course of time.

When I read your article I decided to do something about it and that same evening started to compare its readings with the Avometer. My intention was to shunt or add to the multipliers, resistors, etc., in order to bring the meter "spot on."

However, my patience was not equal to the task and I soon got tired of looking for resistors which would give me the right kind of result. Added to that, the RC Bridge was also playing up.

What the heck, I thought. Why not be done with it and buy a new set of resistors? And that is exactly what I did next day. It was quite an eye opener to see the way in which my friend behind the counter took out a 9,900 ohm resistor, 166.6, 14.8 and all the rest.

It was even more of an eye opener when I wired the resistors in next evening to find the old multimeter once again reading "spot on." What is more I can assure you that it was a lot quicker and easier than fishing around for the right values among the oddments.

About the RC Bridge, it did not take me long to spot the trouble. It is also a "R, TV & H." design but over the last few weeks I noticed that it seemed to be getting less and less positive in its indication.

And no wonder! Since the eye was tending to stay open I reckoned the signal from the bridge was not being amplified properly. A check on the pentode plate of the 6U8 showed little or no voltage and the .22M resistor obviously open circuited or nearly so.

When I replaced the resistor, the Bridge returned to normal and I was able to measure its value. That .22M resistor showed no less than 15 megohms.

So there it is. My multimeter works fine and my RC Bridge is back to normal.

Thanks again for your prompting.

Yours faithfully,
P.H.

However, he was still worried over the fact that the set had—apparently—been struck by lightning. Did this mean that he was taking an unnecessary risk in using the set during a severe storm? Was there a risk of the same thing happening again or could he take refuge in the statistical improbability of lightning striking twice in the same place?

I'm afraid these were questions to which I found it difficult to give a direct answer. For one thing, I hadn't thought much about the problem until now, being inclined to adopt a somewhat fatalistic attitude to such things (if one was marked down to be hit, one would be hit—as it were.) But, even apart from this, it is difficult to nominate the order of risk involved. There are so many factors to be considered that the answer must, of necessity, be inconclusive.

WAS IT REALLY STRUCK?

In this particular case, for example, the first point to clarify was whether the set had really been struck by lightning in the true sense of the word. In fact, it appeared that it had not. What had really happened was that the power lines had been struck and the TV set had been damaged only by reason of its connection to them. Many other appliances would be open to the same risk if they were connected to the mains at the same time.

(I later learned from various colleagues that more than 20 TV sets and a number of refrigerators in the same district had been similarly damaged on that same night. Many were probably the result of the same "strike" that was responsible for the above incident.)

WHAT HAPPENED

As nearly as I can reconstruct things it would appear that the following sequence of events occurred. (1) The power line was struck by lightning, creating a brief high voltage surge probably equal to several times the nominal mains voltage. (2) This surge caused a flash-over between the internal switch contacts and the metal case, causing a certain amount of damage in the process. (3) Once the flash-over had ionised the air, the normal line voltage was able to maintain an arc between the two points.

It is most likely that this was the "flame" which the owner had observed after the picture failed, and it probably continued until the power was cut off by reason of the damaged lug falling away from the switch.

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SD117/400	110	400	2-pin	2	6½	5 3/16	4⅜
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Reverting to the question as to whether a set should or should not be used during a storm, let us consider some of the variables involved. For a start, how severe or how close must a storm be before we consider it dangerous? Again, if we disconnect the TV set from the power, should we not, to be consistent, also disconnect the refrigerator, the radiogram, the stove, clock, food mixer, etc., and possibly the lights as well?

(All this rather reminds me of the storm ritual practised by my grandmother and which I can just remember witnessing as a small child.

Whenever a storm was imminent, she first closed all the doors—draughts apparently had some affinity for lightning—then drew all the blinds, though the reason for this action I never could work out.

Next, all mirrors had to be covered—mirrors attracted lightning, I was told—and, finally, grandma would retire to the darkest corner she could find and throw her black apron over her head. Along with the blind ritual, the reasoning behind this also remained a mystery!)

AERIAL HAZARD

Reverting to modern times, the mere disconnection of the set from the mains is not a complete answer. There remains the aerial, and this is probably as much a hazard as the mains. To be strictly correct, this should be disconnected from the set and suitably earthed, care being taken that the aerial does not become charged while this is being done or, ideally, that the changeover be made by means of a suitable switch, capable of withstanding any surge likely to appear on the aerial.

Years ago it was the practice to fit lightning arresters to all radio aerials. They generally took the form of a narrow gap between aerial and earth terminals, wide enough to prevent any loss of signal, but close enough to allow a moderately high voltage to jump the gap and thus provide a discharge path. However, the accuracy of the gap was all-important and many of the units sold for radio work were so crude as to be virtually useless.

Be that as it may, the need for lightning arresters seems to have diminished over the years, at least in suburbia. Not only have aerials become smaller and less prominent—they are usually inside the house, if not inside the set itself—but the multitude of other objects such as power lines, steel buildings, towers, etc., have all reduced the risk to the occasional outdoor aerial.

COUNTRY AERIALS

Conditions may not be quite the same in the country, though I imagine that, in strong signal areas provided by local stations, most of these will have gone indoors, too.

Further out, of course, the aerial is still likely to be as long and as high as possible—as well as being the most prominent object in the immediate vicinity. It would be interesting to know what precautions, if any, are taken in these cases. Often it may amount to nothing more than simply not listening to the set, due to the roar of static; a rather "head in the sand" type of precaution, I'm afraid.

TV is another matter. Neither sound nor vision channels suffer any serious interference, and there is real temptation not to put the set out of action during a favourite program. Just how much risk is involved, is hard to say, but I have often wondered whether it might not be wise to at least run an earth-wire from the metal mast. After all, many installations extend well above surrounding objects and would appear to be quite vulnerable.

This, of course, will not help in regard to mains surges, the only precaution possible being to completely disconnect the appliance from the mains as already discussed. Once again, it is difficult to assess the odds against being struck, although they may be somewhat less favourable, at least on the basis that one strike may damage a number of sets.

WHAT ODDS?

(Not being a gambling man, I'm not quite sure whether this really alters the odds or not—perhaps some more enlightened reader may like to comment.)

Anyway, it all boils down to the fact that, in practice, nobody seems to worry over-much about this problem. Either they haven't thought much about it, or, if they have, they apparently feel as I do; that the risk is too small to worry about, particularly as, to be consistent, one would have to go to a lot of bother and suffer a deal of inconvenience.

So they just forget about it!

And, to round things off this month, here is a brief comment on an interesting overseas custom.

RADIO TV REPAIR
ART NELSON

"All the hum needed was a little extra filtering." (Radio Electronics.)

Leafing through an American magazine recently, I came across an article dealing with the introduction of "do it yourself" valve testers into drug stores. Apparently it is now commonplace in the U.S. for TV set owners to test their valves in this manner, and, then purchase replacements needed from the drug stores.

I can well imagine this story bringing a smile to many a TV serviceman's face and the thought, "Oh, well, it couldn't happen here."

Why not? This is an age of automation, and vending machine companies are ever on the lookout for additional sources of revenue.

If this sorry state of affairs should ever come to pass here, it will be due,

(Continued on Page 111)

The RADIOMASTER
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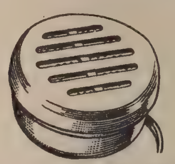

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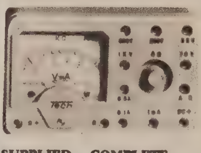

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12K8	10/
EK32	6/9
6SA7GT	9/6
6SH7	5/6
1Q5G	4/
1P5G	2/6
1C7G	3/
1K5G	2/6
1M5G	3/
1K7G	3/
1L5	9/6
6C8G	5/
6SS7	8/6
6H6	2/6
6H6GT	2/6
6K7GT	7/9
6U7G	5/
6J7G	5/
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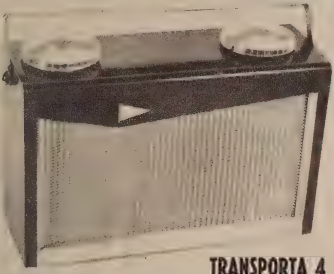

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NEW POTENTIOMETERS

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25,000 ohms 100,000 ohms 500,000 ohms	100,000 ohms. 500,000 ohms.	100,000 ohms. 500,000 ohms. 500 ohms. 5,000 ohms.	50,000 ohms. 100,000 ohms. 500,000 ohms.
5/6 ea. 50/ doz.	2/6 ea. 24/ doz.	3/6 ea. 33/- doz.	1/9 ea. 16/ doz.

25,000 ohm screwdriver adjustment, 1/9.

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PLAYMASTER TAPE ADAPTOR
RECORD ON
MIC
PLAY
REC.
LEVEL

The completed unit is contained in a metal case identical to that used for the No. 1 Unit Stereo amplifier. The case is finished in dark brown enamel with the front panel in beige.

A Tape Adaptor For Amplifier Systems

Here is a device which enables the owner of any Playmaster amplifier described in the past to possess full tape recording facilities, without the full expense—and limitations—of the usual tape recorder amplifier. Completely self-contained, this unit contains preamplifiers, tape equalisation circuits and the bias oscillator. It converts the original amplifier into a versatile tape recording and replay system.

by Jamieson Rowe

IN fact, any high quality amplifier having 15 ohm output and provision for a radio or tape input may be used with this adaptor. The full tone control facilities of the basic amplifier are retained, resulting in a most versatile and high quality recorder.

We have described this unit in response to the many requests from builders of the "Playmaster" series of amplifiers, and owners of many other types. The general query was "can we use our hi-fi amplifiers for tape recording?"

To date, the answer has been "yes, but we can't supply a circuit for the necessary adaptor just at present."

PRACTICAL UNIT

However, due to the pressure of these requests, we have investigated the position involved, and the unit presented in these pages is the result.

But first a word to straighten out any wrong ideas.

Some readers have obviously assumed that the provision of tape facilities is a simple matter, because some commercial Control Units have a "Tape" position on their selector switch. In actual fact, this is seldom more than a wire and a socket by which you can divert signal from a complete, external tape recorder through the domestic amplifier system. It is exactly equivalent to the input socket for a radio tuner.

Some, in addition, have a "tape output" socket by which any signal passing through the Control Unit can be diverted into an external tape recorder.

But these are merely connection facilities and, while they may be handy in themselves, the Control Unit does not substitute for any of the tape recorder's normal functions.

Very few Control Units are intended to accept directly the output from a tape head. We know of none at all which are designed to feed a tape head directly with recording current and high frequency bias.

The reason is not hard to find: The provision of full tape facilities is no simple matter. It involves a lot of complexity, as will be evident from what follows.

Basically, a tape adaptor unit should contain pre-amplification for the signal from the tape, equalisation to produce a tonally balanced output from the preamp, and a recording circuit complete with bias oscillator. In addition, a preamplifier for a microphone is desirable for recording, as most hi-fi amplifiers do not cater for such an input.

Some means of monitoring the recording level is desirable, as is an adjustment, possibly pre-set, to allow optimum recording level to coincide with normal listening level on the amplifier speakers. This point does not concern the user when recordings are taken from a microphone but, when a recording is being taken from the radio, FM or television, it is nice to hear the program too!

TECHNICAL REQUIREMENTS

With these features in mind, we set about developing a suitable circuit. It should be self-contained, we reasoned, since many power amplifiers could not supply the extra drain required by a unit of this type. Most bias oscillators draw about 20 mA at least, which would be additional to that already imposed by the radio tuner.

As for signal connections to the main amplifier, we felt that these should be kept to a minimum, to achieve maximum versatility. One connection to the input and one connection to the output would be ideal.

For the output connection, we first considered a connection to the primary of the output transformer of the power amplifier. Such a connection would give a recording signal of adequate amplitude for direct application to the recording head via a suitable network, making further amplification unnecessary.

However, many may hesitate to make connection to the primary of the output transformer, particularly in a commercial amplifier. In addition, there is a very real danger that circuitry sufficient to operate a record head, and preferably a level indicator of some kind will produce instability in many amplifiers. This is particularly true of high-powered amplifiers incorporating large amounts of feedback and with small stability margins.

ALTERNATIVE

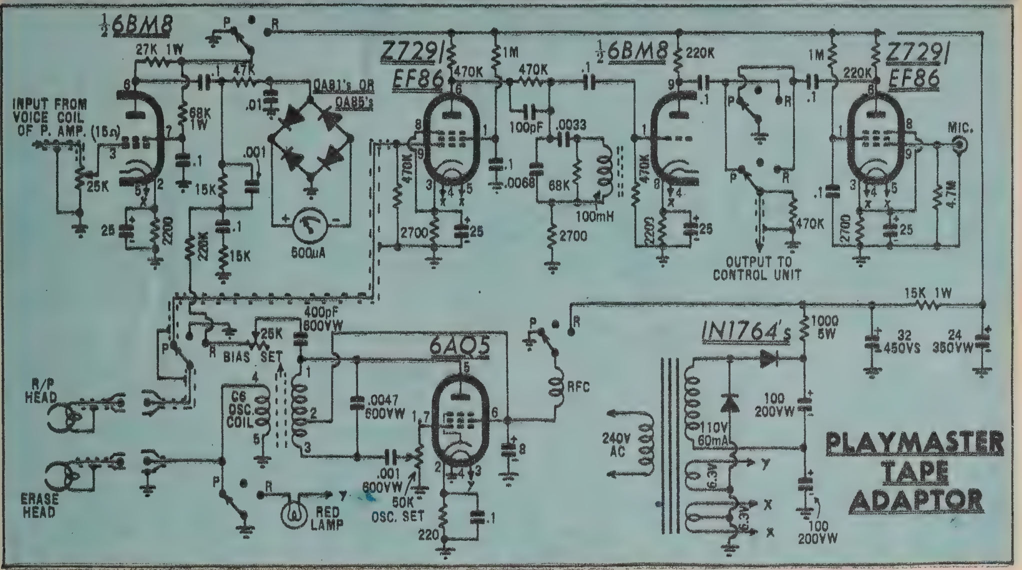
The other way is to take the output connection from the secondary of the output transformer. The signal voltage at this point is much lower in amplitude than that on the primary, due to the lower impedance. Thus the signal requires at least some amplification before recording is possible. However, this is perhaps the safer way and justifies the extra valve.

With voice circuits of less than 15 ohms impedance, some difficulty may be experienced in obtaining adequate signal voltage, at least at moderate amplifier levels.

Where a multi-tapped output transformer is used, connection could be made to the otherwise unused 15 ohm tapping.

In other cases, it may be necessary to arrange for an auto-transformer giving a voltage step-up of not less than

ADAPTOR OFFERS ALL NORMAL TAPE FACILITIES


½6BM8
P
R
27K 1W
.1
47K
OA81's OR
OA85's
INPUT FROM
VOICE COIL
OF P. AMP. (15Ω)
68K
1W
.01
.001
25K
15K
.1
25
2200
220K
15K
500μA
Z729I
EF86
1M
470K
470K
100pF
.0033
.1
.0068
470K
2700
25
68K
100mH
2700
½6BM8
220K
470K
2200
25
OUTPUT TO
CONTROL UNIT
470K
1M
220K
Z729I
EF86
MIC.
4.7M
2700
25
15K 1W
400pF
600VW
25K
BIAS SET
6AQ5
IN1764's
1000
5W
32
450VS
24
350VW
R/P
HEAD
C6
OSC.
COIL
.0047
600VW
RFC
8
100
200VW
240V
AC
110V
60mA
6.3V
.001
600VW
50K
OSC. SET
220
.1
ERASE
HEAD
RED
LAMP
100
200VW
PLAYMASTER
TAPE
ADAPTOR

Here is the circuit for the new adapter. Designed to connect to the main amplifier only at the input and output circuits, it does not require modification of existing equipment. A microphone preamp is provided to increase the versatility.

three to one. The nature of such a transformer would not be critical, the requirements being adequate frequency response and a nominal impedance characteristic which is higher than the voice coil line across which it is to be connected.

Connection to the input system of the basic amplifier is more straightforward. Most control units have a high level input, intended for a radio tuner or similar signal source. Connection to this input means that we must provide a pre-amplifier valve in the adaptor, but this is desirable in any case. It allows us to provide proper playback tone equalisation without having to interfere with the pickup preamplifier or make do with an almost infinitesimal input signal.

FINAL DESIGN

In any case, not all Control Units incorporate a suitably high-gain preamplifier.

The final circuit of the adaptor, shown on these pages, incorporates the features which would thus appear to be necessary in a good quality tape adaptor. Even if not duplicated exactly, it should provide a pattern for those who may care to do some further independent development.

As can be seen, it uses four valves and has a voltage-doubler type power supply incorporating silicon diodes. Recording level is monitored with a rectifier-type moving coil meter circuit.

In the recording function, the signal from the amplifier output transformer secondary is fed to the grid of the pentode section of the 6BM8. Amplitude is controlled by the 25K pot, which can thus be used to match the recording level to a convenient speaker volume. This pot. is adjusted by a screwdriver, and is mounted inside the unit on the chassis.

In practice, it may prove necessary to have some additional control over loudspeaker volume, particularly when using a microphone. This cannot very well be arranged inside the adaptor. Possible courses are to instal a switch to substitute a resistor for the voice coil or, alternatively, to instal a 50 to 100 ohm wire-wound potentiometer to allow for continuously variable control.

The pentode section of the 6BM8 is used as a voltage amplifier, and the output is fed both to the level meter circuitry and to the recording network. The latter network produces a certain amount of recording treble boost, which is standard practice, these days, in tape recorders.

From the recording network, the signal is applied to the recording head, along with high frequency bias from the 6AQ5 bias oscillator circuit. Bias level is adjustable to enable it to be optimised for the particular head and tape used. The bias waveform can be adjusted by the grid potentiometer in the oscillator, which is a Hartley circuit.

FEEDBACK ADJUSTMENT

The pot. actually adjusts the amplitude of the feedback voltage. Too much feedback results in a distorted waveform so that, lacking a CRO for visual inspection, the control should be adjusted for just enough feedback for reliable operation of the oscillator.

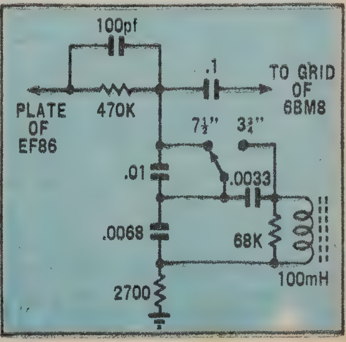
Incidentally, we have incorporated the new Q-plus bias oscillator coil type C6 in the circuit. Besides being cheaper and smaller than the unit previously available, this coil has two most handy features.

One is that it seems to have a higher "Q" than the earlier type OME, resulting in high oscillator output and activity. The other is that it is fitted with a higher impedance secondary winding, which makes it very suitable for connection to erase heads of the higher impedance type. It was actually designed for the Collaro deck, with which it works very satisfactorily, but we found that, in practice, it works well with other decks.

Where difficulty has been experienced, therefore, in securing adequate erase, substitution of this new coil may be worth a trial.

When the adaptor is switched to "record," an in-built microphone preamplifier connects to its output circuit which, in turn, feeds the main Control Unit. Thus recording can be done from a mike merely by turning the control unit selector to the "Radio" or "Tape" input.

Incidentally in many of the R. TV


100pf
.1
TO GRID
OF
6BM8
PLATE
OF
EF86
470K
7½"
3¾"
.01
.0033
.0068
68K
100mH
2700

Here are the modifications required to the replay compensation circuit to enable two speed compensation to be provided.

KITSETS KITSETS

BUILD IT YOURSELF...
...FOR HALF PRICE

1. Reinartz (Batt.) 2
2. " (A.C.) 3
3. S/W 3 Band 3
4. Interstate 5
5. Dual Wave 5
6. " " 6
7. Portagram
8. Portaplayer
9. S/W (Batt.) Con. 1
10. " " " 2
11. " (A.C.) " 1
12. " " " 2
13. All Wave Conv. 1
14 " " 2
15. Playmaster Stereo Control Unit No. 9
16. Playmaster Stereo Control Unit No. 10
17. Playmaster Mono Control Unit.
18. Playmaster Unit Program Source
19. 50 M/cs Conv.
20. 144 " "
21. Transistor 1
22. " 2
23. " 3
24. " 4
25. Transporta 6
26. Transporta 7
27. Transistor 8
28. D/W " 8
29. Transistorgram 4
30. " 7
31. " 8
32. Transistor Stereo Amplifier (1 watt)
33. Transistor Stereo Amplifier (4 watt)
34. Transistor 10 Watt P.A. Amplifier
35. Transistor Signal Tracer
36. Senior Signal Tracer
37. Mullard 3-3 Amp.
38. " 5-10 "
39. " 5-20 "
40. Playmaster 10W. Stereo Amp.
41. Playmaster 17W. Stereo Amp.
42. W/Range Audio Oscillator
43. 5" W/Range C.R.O.
44. 21" 110d. T.V. Kit
45. 6 or 12V Tacho
46. 3" C.R.O.
47. Pattern Gen.
48. Sweep "

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A VERY POPULAR STEREO UNIT
£37/12/6

STEREO CONTROL UNIT NO 9
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£19/10/- ______________ £19/10/-

V.T.V.M. MOD: VT-19
ALL RANGES.: INPUT RES-11 MEGOHM.
OHMMETER RANGE 0.1 OHM TO 1000 MEGOHM.
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& H Control Units, a "Tape" input circuit can be added by installing a suitable input socket and wiring it to the unused position of the 5 x 2 selector switch.

In the replay function, the signal produced by the head passes through a preamplifier stage using an EF86 valve. It is then applied to the grid of the triode section of the 6BM8 via a replay tone equalisation network. Both the EF86 pre-amp and the equalisation network are similar to those used in the "Tape Amplifier No. 3" of June, 1960.

The equalisation network introduces a reasonable amount of bass boost into the signal from the head, to compensate for the poor low-frequency response of the tape-head system. This is in accordance with the NARTB and CCIR standards usually followed by pre-recorded tapes, so that the unit may be used to play back these tapes with good fidelity.

TREBLE BOOST

The network also introduces a certain amount of treble boost, to compensate for falling treble response in the head and tape system. The amount of boost introduced by this circuit is sufficient for many heads of the higher quality variety.

(For a detailed discussion of playback compensation arrangements, refer to the article on tape amplifiers in the June, 1960, issue. This article will show the points to be considered in optimising your particular equipment.)

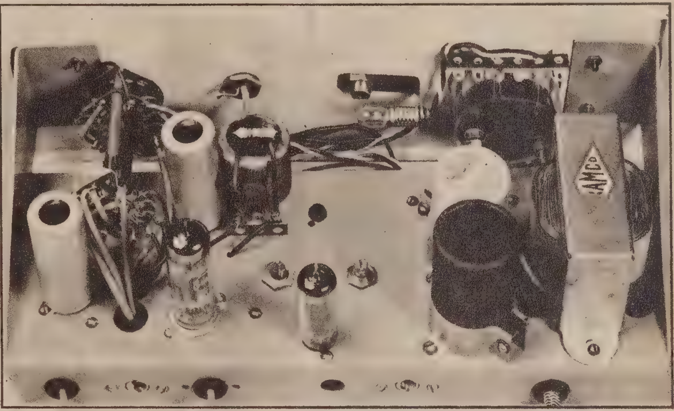
The output of the triode section of the 6BM8 is then fed out to the radio or tape input of the control unit. Full tone adjustment is therefore possible in the normal manner, as the input to the control unit is effectively "flat."

Using a typical commercial tape deck and heads at 7½ ips the output we obtained was flat within 1 dB between 100 cycles and 11 kc/s, with the 3 dB down points at 60 c/s and 12.5 Kc/s.

This was with the Control Unit knobs in the "flat" position. Boost or cut at either could be provided during record and/or playback but such extra compensation has to be used cautiously, to avoid tape overload or dubious frequency balance.

Now a few minor points about the circuit. The level meter circuit uses a 500-microamp movement, the same one used in the tape amplifier of June, 1960. Four OA81 (or OA85) diodes are used in a bridge circuit to rectify the signal.

DETAILS OF CHASSIS LAYOUT



This rear view of the chassis shows the layout of the major components. The power transformer is at the right, with two electrolytics of the doubler circuit next to it. The bias oscillator valve is in the centre of the chassis, and all the amplification stages at the left.

The power supply is a full-wave doubler circuit utilising a couple of 1N1764 silicon diodes. Filtering is achieved by an R-C circuit using the 1K 5-watt resistor and the 32mfd electrolytic.

In the record function, a pilot light behind a red panel bezel is connected to a 6.3-volt winding on the transformer. This light serves as a warning that the recording and erase circuits are energised, to help prevent accidental erasure.

Mechanically, the unit is built on a bracket chassis identical in overall dimensions to that used for the "No. 1 Unit Stereo Amplifier" of April, 1960. It is fitted into a case, which is identical with that used in this unit.

The front panel, looking from left to right, mounts the level meter, the recording pilot light, the microphone socket and the function switch. The microphone socket is placed on the front panel for ease of access.

On the top of the chassis, the power transformer is at the far right. Next to it are the two voltage doubler electrolytics, with the insulated one at the rear.

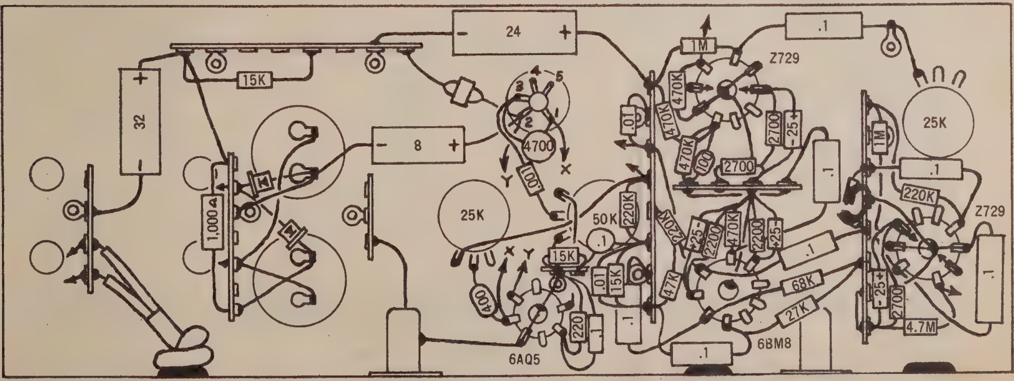
In the centre of the chassis are the bias oscillator components: the bias and oscillator adjust pots and the 6AQ5 valve. At the front is the playback compensation inductor, mounted in a ¾-inch water pipe cap for magnetic shielding. We used a Q-Plus type WFC1 whistle filter coil in this position—but more about this later.

The replay valves are next in line, with the EF86 at the front and the 6BM8 at the rear. The function switch separates these valves from the mike pre-amp, at the far left of the chassis.

LAYOUT DIAGRAM

The underchassis view gives the position of many of the smaller components, but, to make the wiring and component placing job easier, we have included a layout diagram. This does not show all wiring, but merely the placement and orientation of valve sockets, tag-strips and components.

Now some points about the wiring. We suggest you wire in the heater leads first, using lengths of 10/010 (or similar) plastic covered wire twisted together.



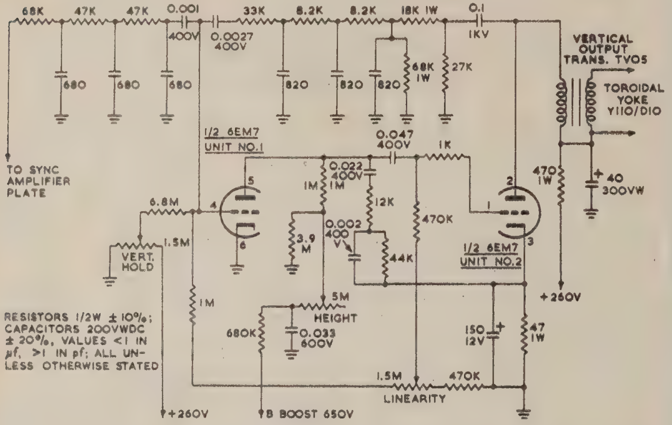
The layout diagram is intended merely as a guide to placement of the minor components. Wiring is shown only where placement may be critical. Note particularly the orientation of valve sockets and the position of tagstrips.

Super **RADIOTRON**

TELEVISION VALVE SERIES

THE VERTICAL DEFLECTION STAGE

Of particular interest to designers of vertical deflection stages is the Super Radiotron 6EM7, a 9-pin miniature twin triode with dissimilar sections. Section No. 1 is a high-mu unit and Section No. 2 a low-mu unit; they are intended for use as a vertical deflection oscillator and vertical output amplifier respectively. The output section is capable of deflecting 114° picture tubes.


68K
47K
47K
0.001
400V
0.0027
400V
33K
8.2K
8.2K
18K 1W
0.1
1KV
680
680
680
820
820
820
68K
1W
27K
VERTICAL
OUTPUT
TRANS. TVO5
TOROIDAL
YOKE
Y110/D10
1/2 6EM7
UNIT NO.1
0.047
400V
1K
TO SYNC
AMPLIFIER
PLATE
0.022
400V
1M
1M
470
1W
40
300VW
6.8M
12K
470K
3.9
M
0.002
400
V
44K
1.5M
VERT.
HOLD
1/2 6EM7
UNIT NO.2
+260V
1M
5M
HEIGHT
RESISTORS 1/2W ± 10%; CAPACITORS 200VWDC ± 20%, VALUES <1 IN µf, >1 IN pf; ALL UNLESS OTHERWISE STATED
680K
0.033
600V
150
12V
47
1W
1.5M
470K
LINEARITY
+260V
B BOOST 650V

The typical circuit shown illustrates the application of the 6EM7; circuit values may need to be altered if other deflection components are used. The circuit is of the "feedback-oscillator" type, which uses the vertical flyback pulse rather than a separate blocking-oscillator transformer to control the discharge valve grid circuit.

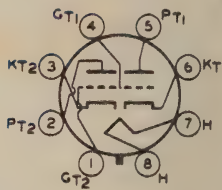
Linearizing feedback networks are eliminated by integrating a sawtooth component on the bias voltage, from the discharge valve grid, to give the required parabolic pulse shape. The more-linear triode characteristics require less correction than those of a pentode. The circuit shows a minimum cathode bias on the output stage to give protection in the event of oscillator failure.

MAXIMUM RATINGS (Design-Maximum Value Except as Noted):

	Section No. 1 (Oscillator)	Section No. 2 (Amplifier)
DC Plate Voltage	330	330 volts
Peak Positive Pulse Plate Voltage (Abs. Max.)	—	1500 volts
Peak Negative Pulse Grid Voltage	400	250 volts
Plate Dissipation	1.5	10 watts
Average Cathode Current	22	50 ma
Peak Cathode Current	77	175 ma
Grid Circuit Resistance (Self Bias)	2.2	2.2 MΩ

6EM7

PIN CONNECTIONS
(bottom view)


GT1
4
5
PT1
KT2
3
6
KT1
PT2
2
7
H
GT2
1
8
H

Pin 1 — Grid of Triode Unit No. 2
Pin 2 — Plate of Triode Unit No. 2
Pin 3 — Cathode of Triode Unit No. 2
Pin 4 — Grid of Triode Unit No. 1
Pin 5 — Plate of Triode Unit No. 1
Pin 6 — Cathode of Triode Unit No. 1
Pin 7 — Heater
Pin 8 — Heater

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

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Press these leads close to the chassis, and keep them clear of low level signal points.

The next things which we wired in were the cathode bias components of the 6BM8, with the bypass capacitors down against the chassis. The rest of the components then can be wired in any order, with the exception of the 27K plate load of the pentode section of the 6BM8. This should be connected last of all in the 6BM8 circuitry, as it obscures the valve socket, once in position.

The earthing around both the EF86 sockets is single-point, to prevent the formation of hum loops. All the earthing is taken to a common point before connection to the chassis, with the exception of the screen bypass of the tape preamp. Due to space considerations this must be taken to an earthing point adjacent to the volume pre-set pot.

HEATER EARTHING

You will notice that there are two heater windings on the transformer. One is earthed on one side, and serves the 6AQ5 oscillator and red recording pilot. The other has its centre tap earthed, and serves the actual amplifier valves. In the transformer we used, both windings were identical, each having centre taps. We cut the unused centre tapping short and insulated it from the chassis.

The function switch is a two-section, three-pole three-position rotary type having the wafers separated by a distance of two inches. We adapted a standard switch by making a couple of new spacers, and extending the centre shaft. The section nearest the clicker plate carries the head and bias oscillator HT switching, while the rear section has the output and 6BM8 HT switching.

The playback compensation inductor, which we placed on the top of the chassis together with its associated capacitors, may of course be taken to a remote speed compensation switch on the tape deck. This would enable the compensation to be altered for speeds other than the standard 7½ ips by switching in different capacitors and inductor shunting resistor.

Depending on where this inductor is actually placed, it may or may not need to be shielded with a pipe socket, to prevent hum pickup.

COMPENSATION FOR 3¾ IPS

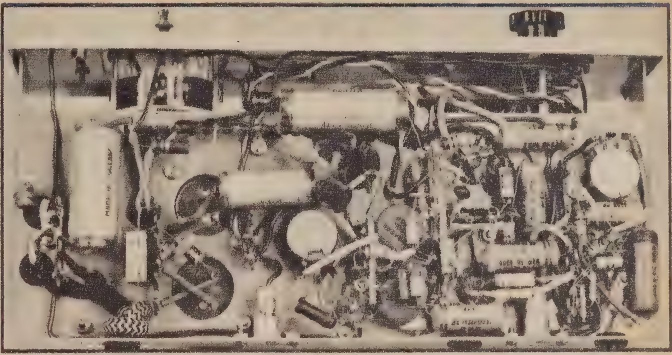
For the benefit of readers who own a Collaro Studio tape deck, we have worked out the change in compensation constants necessary to properly compensate the playback signal on the 3¾ ips speed. These are shown in the small diagram. Adequate compensation should be obtained with these constants on many other decks running at this speed.

The tape head connections are made via small sprung-type audio connectors, while the input and output wiring is simply done with coaxial cable. The cables are connected directly into the circuit at the adaptor, but are terminated in plugs at the other end, to suit the existing amplifier.

There is no mains earth connection to the adaptor unit, the mains cord being a two-conductor cable only. This is to ensure that there are no earth loops between the adaptor and the main amplifier.

Similarly, there is no connection between the shield braid and the main amplifier chassis on the cable from the adaptor to the amplifier voice coil winding. The only connection between the chassis of the adaptor and the amplifier is via the shield braid of the adapter output cable, leading into the control unit.

UNDERSIDE WIRING AND LAYOUT



The underchassis view shown here gives an idea of the layout of the minor components. It should be used in conjunction with the layout diagram at the bottom of page.51.

Construction of the amplifier should present no difficulties if these points are noted. The underchassis photograph and layout diagram will make the position of all components obvious.

A point to notice when setting up the unit for operation is the bias oscillator frequency, as determined by the position of the oscillator coil slug. By screwing out the slug, the frequency should be raised to the point where erasure starts to become incomplete, and then screwed in a couple of turns. The maximum frequency obtainable with complete erasure is that to be aimed at, as discussed in the June, 1960, issue.

Naturally enough, the value of bias and erase voltages (and recording signal, for that matter) required will depend on the particular heads used. The values of components shown in the circuit were found suitable for the variety of heads which we had available, but some heads may require other values for optimum results.

FURTHER ADJUSTMENTS

Components coming under this category are the 400 pF bias feed capacitor, and the components of the recording network attached to the plate circuit of the 6BM8. Readers who feel that they

(Continued on Page 55)

PARTS LIST

1	**Voltage Doubler type power transformer, 110V HT. sec. and two 6.3V windings, centre tapped.**
1	**Bias oscillator coil (Q-Plus type, C6 or similar).**
1	**Rotary switch, 2-section, 3-pole, 3-position.**
1	**Two-inch meter, 500 micro-amp with "level" scale.**
1	**Whistle Filter coil (type WFC1 or similar).**

VALVES AND DIODES

2	**Z729/EF86/6BK8/6267.**
1	**6BM8.**
1	**6AQ5.**
2	**1N1764 silicon diodes.**
4	**OA81 or OA85 diodes.**

RESISTORS

5	**470K ½-watt.**
3	**220K ½-watt.**
2	**1 meg ½-watt.**
1	**27K 1 watt**
2	**15K ½-watt.**
1	**1K 5 watt ceramic cased.**
1	**15K 1 watt.**
3	**2700-ohms. ½-watt.**
2	**2200-ohms. ½-watt.**
1	**68K ½-watt.**
1	**250-ohms, ½-watt.**
1	**4.7 meg. ½-watt.**
1	**68K 1 watt.**
1	**47K ½-watt.**
2	**25K carbon pots.**
1	**50K carbon pot.**

CAPACITORS

2	**100 mfd. chassis mounting electros. (200 volts wkg., one insulated).**
1	**32 mfd. 450 volt surge electro.**
1	**24 mfd. 350 v.w. electro.**
1	**8 mfd. 350 v.w. electro**
7	**0.1 mfd. 400 volt paper.**
2	**0.1 mfd. 100 volt ceramicons.**
4	**25 mfd. 25 volt electros.**
1	**0.01 mfd. 200 volt styroseal.**
1	**0.0068 mfd. 600 volt ceramicon.**
1	**0.0047 mfd. 600 volt ceramicon.**
1	**400 pF. 600 volt styroseal.**
1	**100 pF. 200 volt ceramicon.**
2	**0.001 mfd. 600 volt styroseal.**
1	**0.0033 mfd. 600 volt ceramicon.**

MISCELLANEOUS

2	**Shielded min. 9-pin valve sockets.**
1	**9-pin valve socket.**
1	**7-pin valve socket.**
1	**Chassis type mic. connector.**
2	**Chassis type bayonet audio connectors.**
1	**Pilot light holder and bezel.**

Grommets, tagstrips, an RF choke, connecting wire, mains cord, solder, etc.

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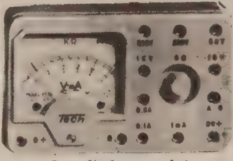

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0 — 500V	0 — 500V	
0 — 1000V	0 — 1000V	

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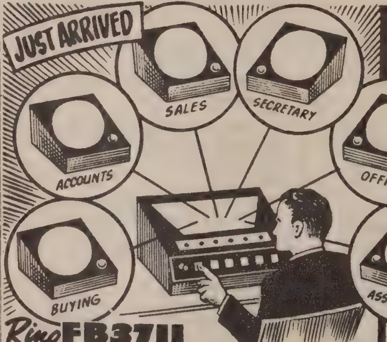

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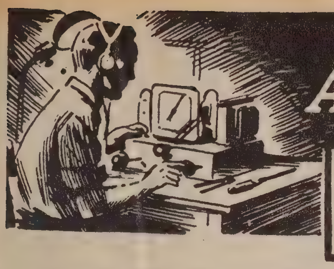
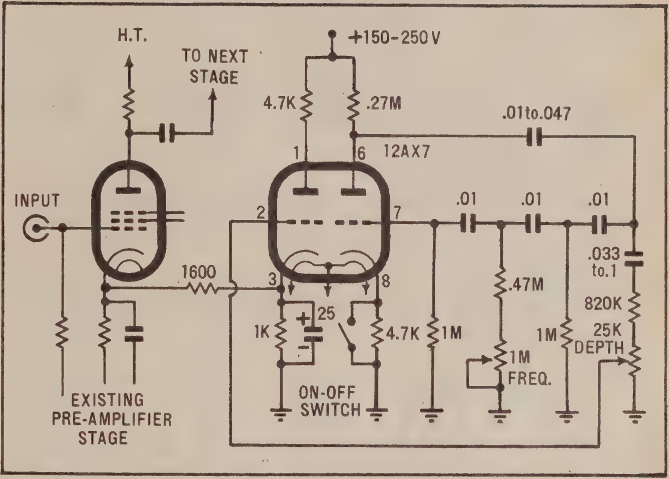


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A VIBRATO CIRCUIT FOR GUITAR AMPLIFIERS

From Mr David Rogerson, of 8 Pisgah Street, Wendouree, Ballarat, Victoria, we received this circuit of a low frequency oscillator, which he is using to provide the vibrato effect in his guitar amplifier.



THE valve used is a twin triode type 12AX7, one section of which is wired as a phase-shift oscillator. In this type of oscillator circuit, a resistance-capacitance network is used instead of a tuned inductance and capacitance circuit to provide the required 180 degrees phase relation between the grid and plate electrodes of the valve.

The low frequency oscillator signal is tapped off at the "depth" potentiometer, which operates as a volume control, and applied to the grid of the left section of the valve. This triode operates as a cathode follower stage, the output signal being picked off from across the 1000-ohm cathode resistor.

The frequency adjust control enables a variation in frequency to be obtained but it may be found that the oscillator will not operate over its full range, because the value chosen was made large enough to provide maximum frequency variation.

An ON/OFF switch is incorporated in the circuit which shorts out the oscillator cathode resistor in the "on" position; in the "off" position, the short is removed and the oscillations decay slowly. If oscillations continue the value of this resistor could be increased to 6800 ohms.

The contributor has this switch mounted in a small box and wired to the oscillator via a 6ft length of microphone cable, thus enabling him to control the vibrato remotely with his foot.

The contributor also tells us that the component values are not critical except for the 1600 ohm resistor he used for coupling the cathodes together and the 820K ohm in series with the depth control. The capacitor in this leg of the phase shift network, and the feedback capacitor may also require some experiment to improve the intensity or depth and also maintain oscillations over a greater range of the frequency adjust control.

As stated previously, the oscillator output is developed across the low impedance cathode resistor of the cathode follower circuit. The 25 mfd by-pass condenser has no noticeable effect at the vibrato frequency but provides suitable AF and RF by-pass to eliminate any noise generated by the ON/OFF switch.

The original circuit had the cathode of an EF86 pre-amplifier stage returned to earth via a 1600 ohm resistor and the 1000 ohm bypassed resistor in the cathode follower. It is suggested that, if the existing cathode circuit of this pre-amplifier is involved in the feedback loop, then the two cathodes could be linked as in the circuit so as not to upset the existing amplifier unduly.

Although this method of connecting the oscillator does not provide for proper mixing, it does produce an amplitude modulation of a type and creates quite a pleasing effect.

A TAPE ADAPTOR FOR AMPLIFIER SYSTEMS

(Continued from Page 53)

are not obtaining optimum results with their particular heads using the value given for these components should refer to the June, 1960, article. Suggestions were given in this article for experimental alteration of circuit constants.

While the physical layout we have described probably will appeal to most readers as being the most logical, there is no reason why the unit may not be built in other forms to suit individual requirements.

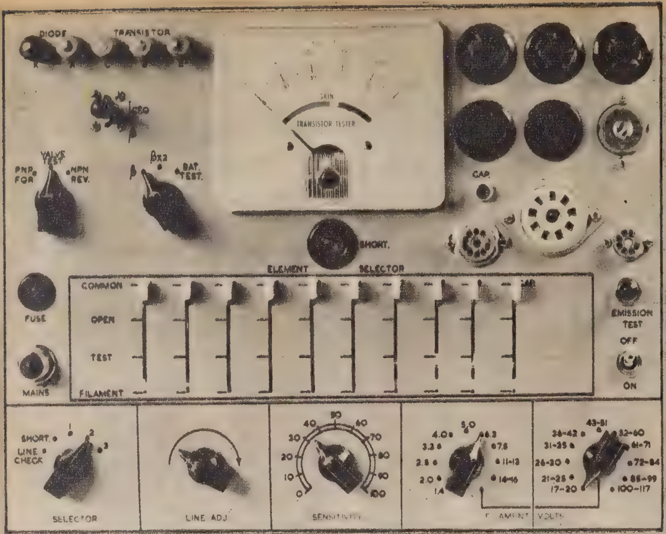
However, some care will be necessary to ensure that such problems as hum due to earth loops, instability due to coupling between adjacent wires, etc., are not introduced. In short, unless the reader is quite sure he appreciates these problems and can cope with them, it might be wise to follow the original design.

This completes the description of our newest tape adaptor. Judging from the many requests which we have received for such a unit, it should find many uses in the audio systems of many of our readers. Given an existing amplifier of suitable quality and an appropriate tape deck, the results are certainly not to be scoffed at!

3in. C.R.O.—NOTE

Further practical experiments with our 3in C.R.O. suggest that it may be advantageous to make some minor changes to some component values. These are aimed at minimising phase shift in the horizontal amplifier when the instrument is used for TV alignment. The changes are as follows:

1. Omit 25 mfd capacitor associated with pos. 2. S3c.
2. Change 820 ohm to 330 ohm pos. 2. S3c.
3. Change 2200K ohm to 68k ohm pos. 2. S3b.
4. Change 2200 ohm in vertical O/P and probe H.T. supply, to 1500 ohm 1 watt.



Our completed valve and transistor tester showing the hand-lettered panel and temporary meter scale. Arrangements are in hand for the supply of an etched panel and a new, specially calibrated meter scale.

R.TV.&H. VALVE AND TRANSISTOR TESTER

As promised last month, we are presenting in this article the construction details of a practical service type valve tester, capable of providing in a simple way, information on the condition of valves normally encountered in service practice. At the same time, we have incorporated in the completed instrument our transistor tester, described originally in the August, 1960, issue.

By Alan Nutt

IT thus becomes a very versatile piece of test equipment, eliminating much of the guesswork often associated with the testing of radio equipment, particularly in regard to valve failure.

By keeping the operation simple, it is possible to check the condition of even a large number of valves in a relatively short space of time. It is no hardship to test customers' valves, when handed over the counter and, at the same time, will allow the customer to see for himself on the simple "Good/Bad" meter scale, the condition of the valve under test.

The range of valves that can be tested on such an instrument is virtually unlimited, the only requirement being that two or preferably three, known good valves of each type be previously available for calibration purposes. We will have more to say later on regarding the actual calibration procedure to be adopted.

The biggest problem that faced us in the design of the tester was the supply of the necessary specialised components.

In order to make the operation as flexible as possible, it is necessary to have some control over the connection to each separate pin on the socket of the valve under test. This requires that an independent switch section be provided for each pin, as well as for any top cap.

From this, it is obvious that up to ten switches will be required, in order to meet every possible type at present in use. We considered the possibility of using normal rotary type switches but the operation, we felt, would become too clumsy.

As it happens, a local manufacturer has now made available on the local market a type of switch that is well suited for a project of this type.

This switch, while essentially still of the rotary type, is provided with a lever arm which greatly facilitates its operation. Due to the method of mounting, the requisite number of switches can be "stacked" in a relatively small space. The manufacturer, Paton Electrical Pty. Ltd., made the latest model of this switch available to us for trial in our tester and it proved very satisfactory indeed.

The second special item was the power transformer, with its multiple tappings for line adjustment and filament voltage selection. Here again, however, one of the local transformer manufacturers came to our assistance and built a transformer to our specifications.

Both the switch and transformer should be available through normal sources by the time this issue goes to press.

Coming to the circuit in detail, it will be noted from last month's discussion of the various types of valve tests, that our tester provides for an emission and shorts test. This is in the interests of simplicity of operation.

CHEAPER MOVEMENT

The transistor testor has been incorporated, more or less in its original form, the only difference being the use of a cheaper 500-microamp meter and the deletion of the "Iceo x 5" push button.

This button is only used occasionally and we felt that, in the present instrument, it could well be sacrificed in order to use a cheaper meter movement than the 100-microamp unit originally specified.

The 1N1763 diode has been retained as a very necessary protection device in the event of transistors under test possessing bad short circuits. The 6.85 ohm resistor changes the meter range from 500 microamps to 10 milliamps for beta measurement.

Two extra poles have been added to switch S6 in order to switch the meter from transistor tester to valve tester. This switch still allows the transistor battery voltage to be tested even though the valve tester may be in use.

Some readers may not wish to build the transistor tester at all and, in such cases, the meter would be connected from the common arm of S5a to S5b and the entire transistor circuit deleted.

The valve tester section is quite straightforward and presents no special problems in construction, apart from the unusual amount of actual wiring involved. Switch S5 is the main function switch and selects the various operations to be performed.

The first position is the Line Check in which the meter is connected across the 30 volt winding of the transformer in series with a multiplier resistor and small diode. The actual value of resistor worked out in practice at the odd value of 28K ohms which we made up with a 27K and a 1K in series. The line voltage adjustment is carried out by the two sections of S2.

In order to reduce the total number of transformer taps required, the primary of the transformer was tapped in 10 volt steps from 205 volts to 255 volts and an additional 5 volt winding added at the common end. By selecting each of the 10 volt taps in turn and alternating the other mains lead between the common tap and the 5-volt tap it is possible to adjust the primary voltage in 5 volt steps from 205 to 260 volts.

This adjustment is the first one carried out to ensure that, at all times, both the applied test voltage of 30 volts and the selected heater or filament voltage is set at the correct value. Without this check, variations in mains voltage could lead to quite erroneous readings.

The next function selected is the Shorts test which, as mentioned last month, must be carried out before the actual emission test, in order to prevent overload to the meter movement that could take place as a result of shorted elements within the valve.

LIMITING IMPEDANCE

A test voltage of 150 volts is applied between each electrode in turn, as selected by the lever switches, and all the other elements tied together. The 70-volt neon lamp is connected in series with the supply voltage and will light if a short actually exists between any elements. The .047 capacitor is included to prevent ignition of the neon lamp by normal cathode current flowing through the valve and the value is so chosen as to act as a limiting impedance in series with the lamp.

The 680K resistor across the lamp itself is also a de-sensitising component, the idea being to prevent the lamp responding to equivalent leakage paths above about 2 megohms. If these precautions were not taken, moisture and dirt on the base of the valve under test could quite likely give rise to excessive flicker in the neon.

The 15K resistor in series with the lamp is included merely as a precautionary device in the event of a short occurring in the series capacitor. Some measure of protection is thus afforded the lamp itself. Incidentally, when purchasing the lamp, it should be specified that no series resistor be included.

The next three positions of the function switch select the appropriate range for the emission test. As mentioned last month, a 5K resistor is included in series with the test electrode in all battery valves undergoing an emission test. This value is reduced to 1K for all normal pentodes, triodes, etc., but is further reduced to 200 ohms for all power valves, including rectifiers.

POSITIONS

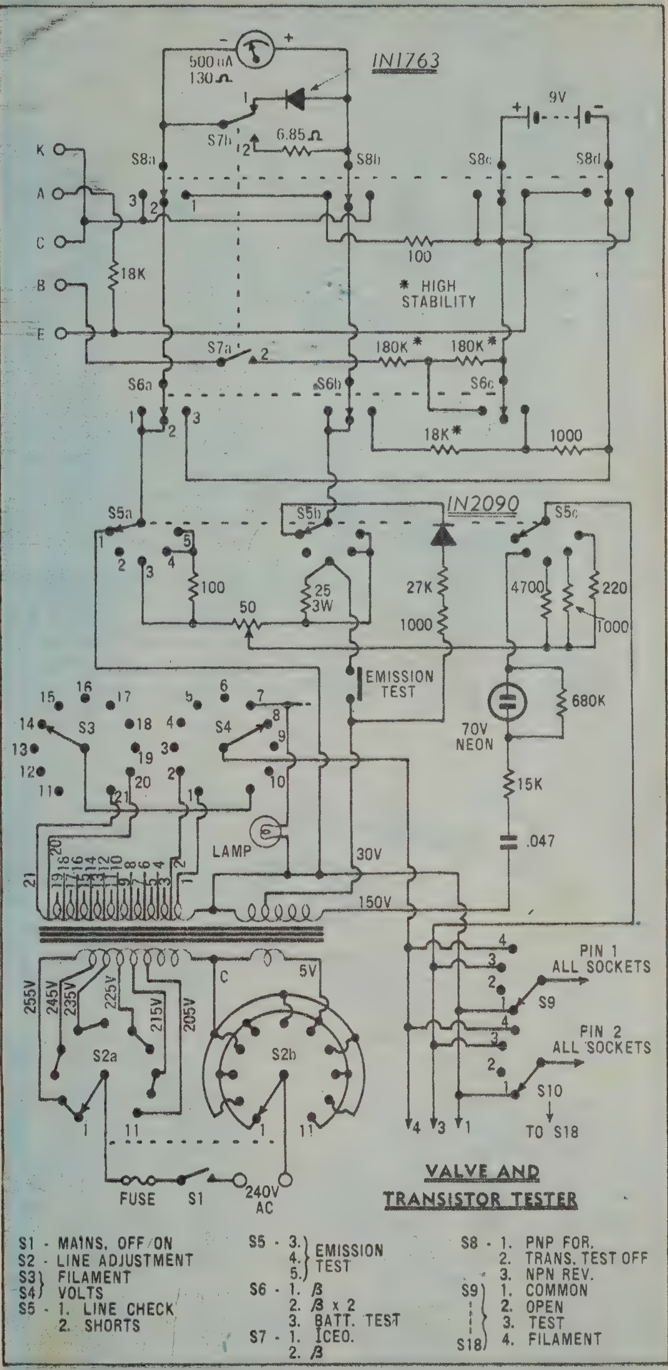
Position 1 of the three emission positions on the function switch is selected for all battery valves and other low emission type valves. Position 2 is for all other types with the exception of the previously mentioned power valves and rectifiers, which should be checked on position 3.

The 25 ohm and 100 ohm resistors associated with the sensitivity control potentiometer are used to prevent the calibration settings from being crowded at one end of the scale.

The taps provided on the filament winding of the transformer are so designed that, by applying a tolerance of plus or minus some seven or eight per cent to the nominal value, the full range of heater voltages likely to be encountered in practice is effectively covered. It will be noticed from the photograph of the front panel that the calibrations on the filament voltage switch are not all single voltage values but extend over a range.

Regardless of the heater voltage of

CIRCUIT OF NEW VALVE TESTER


500 uA
130 Ω
IN1763
9V
6.85 Ω
S7b
S8a
S8b
S8c
S8d
K
A
C
B
E
18K
100
* HIGH STABILITY
S7a
180K *
180K *
S6a
S6b
S6c
18K *
1000
S5a
S5b
IN2090
S5c
100
50
25 3W
27K
1000
4700
220
1000
EMISSION TEST
680K
70V NEON
15K
.047
S3
S4
LAMP
30V
150V
255V
245V
235V
225V
215V
205V
C
5V
S2a
S2b
FUSE
S1
240V AC
PIN 1 ALL SOCKETS
S9
PIN 2 ALL SOCKETS
S10
TO S18
VALVE AND TRANSISTOR TESTER
S1 - MAINS, OFF/ON
S2 - LINE ADJUSTMENT
S3 } FILAMENT
S4 } VOLTS
S5 - 1. LINE CHECK
2. SHORTS
S5 - 3. } EMISSION
4. } TEST
5. }
S6 - 1. β
2. β x 2
3. BATT. TEST
S7 - 1. ICEO.
2. β
S8 - 1. PNP FOR.
2. TRANS. TEST OFF
3. NPN REV.
S9 } 1. COMMON
2. OPEN
3. TEST
S18 } 4. FILAMENT

Although the circuit may seem complex at first glance, it may be broken up quite simply into individual test sections. Very few components are actually involved and layout presents no special problems.

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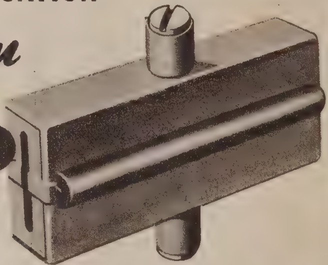

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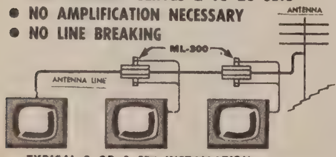

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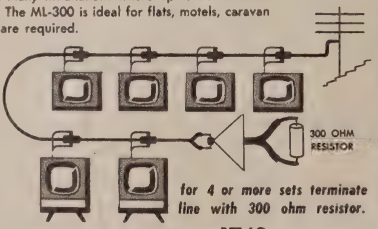

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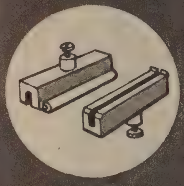

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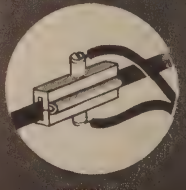

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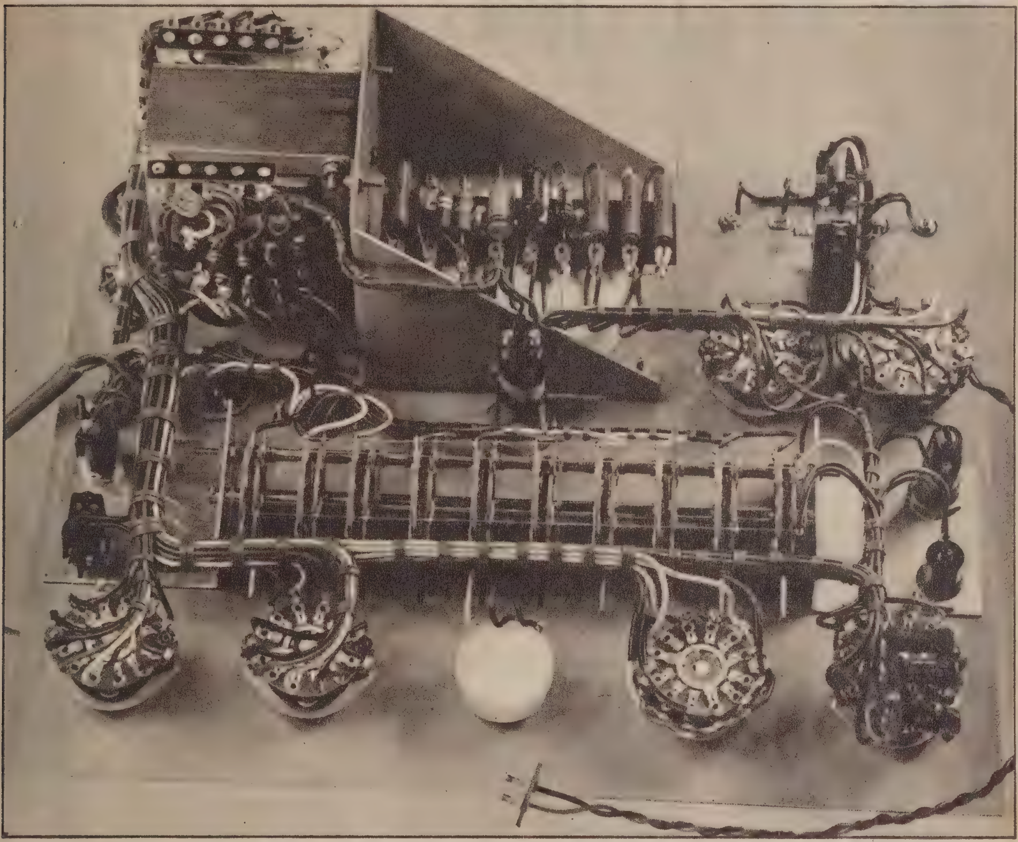
REAR VIEW SHOWS POSITION OF CABLE FORMS



This rear view of the tester clearly indicates the layout of the cable form and switch wiring. The majority of components are mounted on the terminal panel at the rear of the meter; the remainder are wired directly on to the switch wafers with which they are associated.

the valve under test, a voltage can always be selected that will be well within the manufacturer's normal tolerance rating of 10 per cent.

The fact that a particular heater might be slightly hotter or cooler than normal does not affect the operation of the instrument, as each valve type is calibrated against a known good valve which will have exactly the same voltage applied, the emission test providing a means of comparison only.

We have used two eleven-position switches for the selection of heater or filament voltage, the extreme position of the first switch bringing in the ranges of the second switch. Ideally these switches, as well as those associated with the line adjustment, should be of the non-shorting type but, as these are not normally available ex stock, we used the type with the shorting rotor.

This is quite in order providing one does not dwell for long periods between switch positions, otherwise arcing and overheating will appreciably shorten the life of the switch. Possible trouble can be avoided, of course, by setting the heater voltage before the tester is switched on.

The four-position element selector switch enables the appropriate heater or filament pin to be selected and applied to the heater source. Each element may be selected in turn and placed in the test position for the shorts test and then the test electrode selected for the emission test, either the control grid with normal valves, or the plate in the case of diodes.

CONSTRUCTION

The instrument is constructed almost entirely on the front panel, with the exception of the power transformer for which a special bracket is provided. This bracket is fastened to the panel by the four screws holding the meter in place. We suggest that if making your own panel, you complete all the drilling and filing before commencing the assembly of switches and the actual wiring.

The panel should then be sprayed and lettered, if desired, using some form of lettering guide or stencil. A final coat of clear lacquer will prevent the lettering being accidentally rubbed off during wiring and also during future use.

All components should now be assembled on to the panel. The lever switch bank has two "L" brackets mounted at the ends and these brackets are held to the panel at one end by the fuse holder and lamp bezel and at the other by the mains switch and the emission test switch.

Before mounting the power transformer, the valve sockets should be wired completely. We have not shown the sockets wired in the schematic diagram for the sake of clarity, but there should be no difficulty once the job is under way.

All the number one pins are joined and go to the common of one switch section. Then all the number two pins and on to the second switch section. Don't forget the top cap jack which connects to the tenth bank of the switch.

In order to facilitate the identifying of the leads, we suggest you use the greatest variety possible in wire colours. In our own model, we adhered as much as possible to the standard colour code, brown-1, red-2, orange-3, etc. The value of this can be appreciated when one realises that when wiring the final cable form to the power transformer, one has approximately three dozen leads to identify.

The valve sockets should be of the Amphenol type with the spring mounting clip. Other types with a mounting flange

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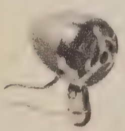

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will take up too much space on the panel. Although we have specified several definite types of socket, this by no means exhausts the possible range and the constructor can decide for himself whether he wants to add Continental types or delete the loctal types. If other types are added the only point to bear in mind is the connection of pin 1 to all the other number one pins and so on.

The panel holding the majority of the components should have two holes drilled in the centre for the meter terminals prior to the actual mounting of the components themselves.

All other resistors not on the panel are conveniently fitted on the switches with which they are associated. The three resistors connected to S5c may best be mounted between the two wafers, utilising the unused section of the lower wafer as an anchor point.

As indicated in the rear view photograph, all wiring has been gathered into convenient cable forms. This method of wiring makes for neat assembly and easier identification of the leads. The three-lug strip for the power cable is fastened under one of the nine-pin loctal socket mounting screws.

MOUNTNG

We have not specified any particular type of case for the instrument, as individual constructors will have their own ideas on how such a piece of apparatus should be mounted. Some, doubtless, will want to mount it in a case suitable for carrying. Others may want to panel mount it or place it in either a horizontal, sloping or vertical case. We have left it, therefore, to the constructor to decide, although popular choice will probably dictate what becomes most readily available on the market.

Before the completed tester can be put into use, calibration settings must be determined for each type of valve that it is desired to test.

This will necessitate, as mentioned before, two or three preferably new valves of each type in order to obtain an average "Good" emission reading.

From a valve data book the following information should be noted down: Heater voltage and pin connections, control grid connection, diode anode connection, any other pins connected to common elements or filament taps.

Having determined this information for each valve for which calibration is desired it is now possible to set up the various functions of the tester in order to obtain the correct setting of the sensitivity control.

At this juncture, we should mention that some form of table or chart must be provided in order to preserve for future reference the settings determined for each valve. We suggest that the chart be in loose-leaf form so that additions can be made and some semblance of numerical or alphabetical order retained.

We are investigating the possibility of printed charts, with headings provided for each function switch. These sheets would, of course, be uncalibrated and it would be left to the individual to enter the various settings for his own instrument. However, we are unable, at the moment, to promise anything definite.

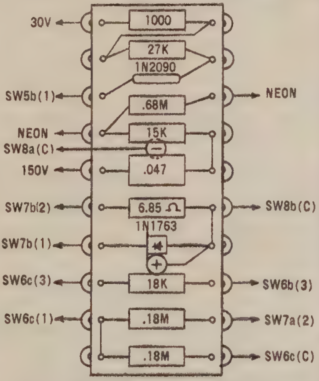
Prior to applying the mains voltage, the filament voltage switch should be set to the correct value, or the range which includes the rated value of the valve to be tested. All element selector switches must be in the "Common" position before the valve is plugged into the appropriate socket.

The element selector switch corresponding to one of the filament or heater pins should now be placed in the "Filament" position. Any pin connected to a filament tap must be placed in the "Open" position to prevent shorting out one half of the filament.

If the particular valve has two pins common to one end of the filament, as in the case of a 1T4 and several other battery valves, the common pins may be left in the "Common" position and the other filament pin connection placed in the "Filament" position.

The valve may now be plugged in and the mains voltage applied.

After a suitable warm-up time has elapsed, switch the selector switch to "Line Check" and advance or retard the line adjustment switch until the meter reads just full scale.



Panel diagram showing placement of components. The panel is fastened under the meter terminal screws indicated in the centre of the board. Almost any small diode will do in place of the 1N2090.

The selector switch is now turned to the "Shorts" position and each element selector switch placed in turn in the test position and then returned to the "Common" position.

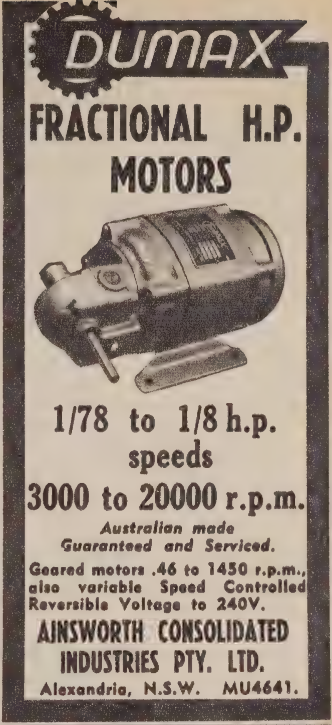
If a short exists between any pins, the neon indicator will glow when the particular pins concerned are placed in the test position. A brief flash from the neon as the switch levers are moved into the test position is quite normal and is due to the capacitor in series with the neon receiving a charging pulse.

"NORMAL" SHORTS

It must be remembered that there are certain pins that will normally exhibit a short, namely, the second heater or filament pin, any filament tap or any pins that are common to the one electrode. These "normal" shorts should be noted down on the chart so that, in future tests, no confusion will result from an incorrect interpretation of the neon indicator.

It is a good idea to tap the valve gently while carrying out the shorts test, as those of an intermittent nature may not show up unless subjected to some vibration.

Assuming all valves have indicated satisfactorily on the shorts test, the selector switch should now be turned to either positions 4, 5 or 6 depending on the type of valve undergoing test as mentioned previously. The element selec-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1	6V pilot lamp and bezel.
1	Panel mounting fuse holder and fuse. (1 amp.).
1	9-volt battery and plug.
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1	1N2090 diode or similar.
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2	1-pole, 11-position rotary switches
1	2-bank, 2-pole, 5-position rotary switch.
1	2-bank, 3-pole, 3-position rotary switch.
1	3-pole, 3-position rotary switch.
1	DPDT key switch. (P.M.G. type).
1	SPST toggle switch
5	Spring terminals (2 red, 1 black, 1 green, 1 blue).
7	Pointer knobs.
1	4-pin socket.
1	5-pin socket.
1	6-pin socket.
1	7-pin socket.
1	7-pin miniature socket. (B7G).
1	8-pin socket.
1	8-pin loctal socket.
1	9-pin loctal socket.
1	9-pin noval socket. (B9A).
1	Banana pin jack and plug.
1	.047 mfd., 400V paper capacitor.

RESISTORS

(All ¼w unless otherwise stated).

1	680K 1W.
2	180K 1W 1 per cent.
1	27K 1W 1 per cent.
1	18K 1W 1 per cent.
1	18K.
1	15K.
1	4.7K 5 per cent.
1	1K 1W 1 per cent.
1	1K 5 per cent.
1	1K.
1	220 ohms 5 per cent.
1	100 ohms 3W.
1	100 ohms 1W 5 per cent.
1	50 ohms WW potentiometer.
1	25 ohms 3W.
1	6.85 ohms 1 per cent (10mA meter shunt).

SUNDRIES

1	10 lug panel.
3	5 lug terminal strips.
1	3 lug terminal strip.
	Hook-up wire, nylex tubing, scrap aluminium for lever switch mounting bracket, power flex and plug, nuts, bolts, solder, etc.

tor corresponding to the control grid pin or cap as the case may be, should now be placed in the "Test" position and the sensitivity control set to zero.

Press the emission test button and advance the sensitivity control potentiometer until a reading of about 90 per cent is obtained on the meter. Note the control setting and repeat the range of tests for the other valves of the same type, finally taking an average of the sensitivity readings thus obtained and entering it in the table as the calibration setting for that particular type of valve.

In multi-section valves, separate tests should be given to each section, including diodes, as well as each anode in the case of full wave rectifiers. Dual valves should have the control electrode in each section checked separately.

Operation of the transistor tester simply requires firstly that S6 be placed in the Battery Test position in which case the meter reading should read above 8.1 volts. If not, the battery should be replaced.

OPERATION

With S8 in the "Valve Test" or transistor "Off" position, connect the transistor leads to the appropriate terminals and then turn S8 to either PNP or NPN depending on the type under test. The emitter-collector leakage current can then be read directly on the 500uA scale on the meter. Should the meter read hard over, the transistor is either shorted, in which case it may be discarded, or it is a high power type which cannot normally be tested on this instrument.

Assuming the leakage current to be normal, the key switch, S7, may be depressed and the common emitter current gain, Beta, read on the 0-200 scale if S6 is in the Beta position, or on the 0-

(Continued on Page 107)

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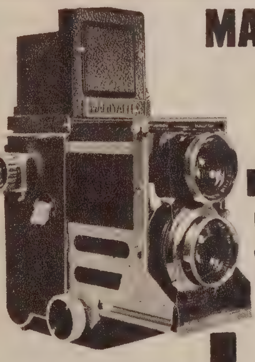

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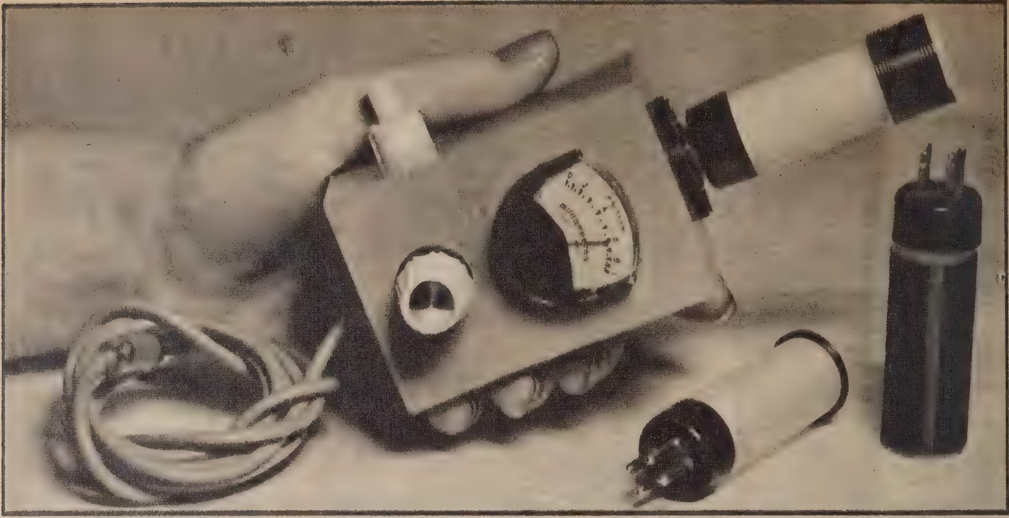


The finished adaptor is a compact unit which may be used with any signal generator or service oscillator to provide "grid dip" facilities. The front panel knob is the zero setting control and the press button is the battery switch. Three coils cover from the broadcast band to VHF.

Adaptor Substitutes for G.D.O.

One of the most valuable items in any ham shack or workshop is a grid dip oscillator. However, it may not be generally appreciated that a conventional service oscillator or signal generator may be used in a similar role by fitting a simple adaptor. Here is a description of such a unit which is simple, compact, and economical.

By Keith Jeffcoat

THE grid dip oscillator, sometimes known as the "grid-dipper" is a very useful instrument. It can be employed not only for resonance measurements, but also for checking such characteristics as capacitance, inductance, "Q," bandwidth, and the properties of antennas, transmission lines, crystals, and filters.

In the early days of radio, it was noticed that the DC grid current of an RF oscillator was very sensitive to resonance in nearby tuned circuits. The grid current would "dip" or decrease as the external circuit was tuned to the frequency of the oscillator, or vice versa.

MORE SENSITIVE

The important thing about this effect is that the grid-current dip, so obtained, gives a more sensitive indication of resonance than can be obtained with a simple absorption type wavemeter. Making use of this effect, it is possible to construct a tunable RF oscillator with a grid microammeter which can be used to measure the frequency of "dead" tuned circuits. As with the wavemeter, no direct connection is needed, inductive coupling between the oscillator and the circuit under test being sufficient.

Just how does a grid dip oscillator work?

Fig. 1 is a simple Colpitts oscillator whose frequency is governed by the coil L1 and capacitor C3. A DC microammeter M1 is connected in series with the grid resistor R1 and the needle is deflected when the circuit is oscillating.

The RF current flowing in L1 and C3 makes the grid alternately positive and negative with respect to the cathode. A diode is formed with the grid acting as the plate of the diode, and rectification takes place.

During the half cycle when the grid is positive, electron current flows from cathode to grid, through resistor R1, meter M1, and back to the cathode, causing deflection of the meter proportional to the strength of oscillation and the setting of the sensitivity control R2.

If an external tuned circuit Lx—Cx is inductively coupled to the grid coil L1 and either circuit is adjusted until both are resonant at the same frequency, the circuit Lx—Cx will absorb energy, from the oscillator tank L1—C3.

The reduction of energy causes the RF voltage across L1 to decrease whereupon the grid current reading will drop or "dip". Minimum coupling between the test circuit and oscillator coil increases the accuracy by sharpening the response.

The grid dip adaptor follows this same principle of energy absorption and allows us to make use of an RF signal generator to perform the same functions as a grid dip oscillator.

Fig. 2 shows the basic circuit arrangement of such a grid dip adaptor.

It consists of an untuned coil L, diode D, and a DC microammeter M, connected in series across the output of an RF signal generator. The resistor R is provided to complete the DC path of the diode and is only required when there is a blocking capacitor in the output circuit of the generator.

RF from the signal generator passes through the probe coil L, is rectified by the diode D, and the resultant DC deflects the meter M.

This coil L is untuned in the conventional sense, serving only as an exploring coil. Fairly obviously it will be self-resonant with its own distributed capacity, but this is arranged to fall outside the range for which the coil is specified.

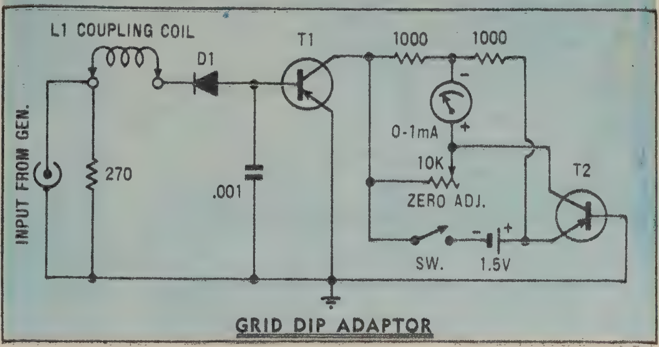
GDO EFFECT

When an external test circuit Lx-Cx is coupled to the probe coil L in the same manner as with GDO, the meter current will dip when the generator is tuned to the frequency of the circuit under test. The resonant frequency of the circuit is then read from the generator tuning dial. The generator may be modulated or unmodulated, although modulation will add nothing to the performance of the adaptor.

A very sensitive DC microammeter would be necessary in the circuit shown in Fig. 2, due to the low RF output voltage delivered by the average signal generator. Our own tests showed that a sensitivity of at least 10 microamps is desirable.

Since such a meter is both costly and difficult to procure, it was decided to use a locally available O-1mA meter of only 1¼in diameter, in conjunction with a transistor DC amplifier, and so reduce

ADAPTOR USES DC AMPLIFIER



The circuit of the final design. Main feature is the transistorised DC amplifier to boost the meter sensitivity. The meter is connected in a bridge circuit to eliminate standing current and permit a true zero setting.

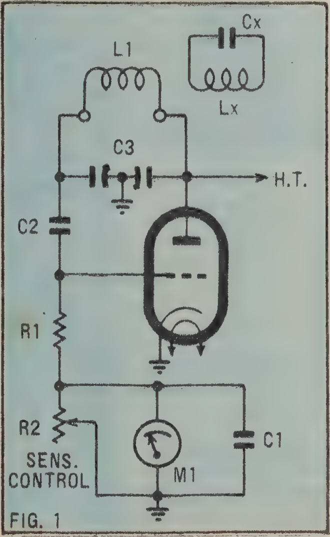


FIG. 1

Basic circuit showing the principle of operation of the grid dip oscillator.

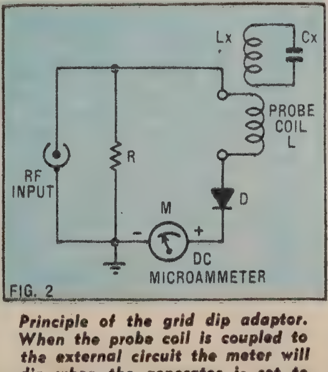


FIG. 2

Principle of the grid dip adaptor. When the probe coil is coupled to the external circuit the meter will dip when the generator is set to the resonant frequency of Cx, Lx.

both the cost and size of the finished unit.

The transistor DC amplifier, shown in the main circuit, is essentially a current amplifier in which the base of T1 is used as the input electrode, the emitter being grounded. When used in this way a small change is base current produces a large change in collector current.

The second transistor is wired as a common emitter amplifier stage connected in cascade to give 10 microamp operation of the meter. It would have been possible to connect the meter directly into the collector circuit of T2 and in this condition a signal applied to the base of T1 would produce deflection of the meter. This would, however, leave us with some meter deflection at all times, due to the standing current of the transistor T2.

BRIDGE CIRCUIT

In order to compensate for this standing current, which will vary with temperature changes, the meter is wired in a bridge circuit, one pair of arms being the two 1000 ohm resistors and the other pair the 10K pot and the collector-emitter circuit of the transistor. This allows us to set the meter to zero and so make use of the whole of its available movement.

A number of different transistors were tried in this circuit and, except for some variation in gain, all produced good results. The final unit used a CK718 as T1 and an OC70 as T2, mainly because they happened to be on hand. Any of the transistors mentioned in the parts list will work just as well and no change in circuit values should be necessary.

Note the direction in which the diode D1 is connected. It is opposite to what one might normally expect. This is necessary in order that the base of the transistor will receive negative DC output.

The adaptor is built in a copper case measuring 3in long, 2in wide, and 1½in deep. Our unit was soldered together on the inside and finished with a coat of grey duco for appearance's sake. Almost any other easily soldered metal would have served for this job; even a piece of old biscuit tin, suitably finished, would not be out of place.

LAYOUT

Looking at the photograph of the unit, it can be seen that the four pin probe coil socket is mounted on top of the case immediately above the 0-1 mA meter on the front panel. The 10K zero pot is mounted below the meter with the on-off switch on its left side. A 3/8in hole fitted with a rubber grommet in the bottom of the case provides an exit for the lead to the generator.

Looking at the unit from the rear the on-off switch is seen at bottom left with he 10K zero pot below it. The 0-1mA meter is just to the right of this pot nd the two 1000 ohm resistors are mounted below the 1½ volt pencil torch attery.

To the right in the photograph can e seen the four pin plug, with the iode mounted above it and the transisor T1, mounted at the top right. The 70 ohm diode return resistor is wird from one lug to the four pin socket o an earth lug secured under the socket mounting bolt, and the transistor T2 can e seen below this resistor.

No trouble should be experienced with the wiring of the unit, but it is necessary to attach two leads about three inches long to both the switch and battery before mounting them in the case.

Both ends of the battery should be insulated with cellulose tape, or something similar, as neither end should be allowed to come in contact with the case. The battery should be the last component to be soldered into circuit, otherwise there is some danger of damage being done to the transistors.

Only three coils are needed with the unit since they are aperiodic, and usable over a wide frequency range. The frequency at which each is self resonant with its distributed capacitance must be avoided, since a false response would be obtained at that frequency. To prevent this trouble, the maximum recommended frequency for a given coil is chosen considerably lower than the self resonant frequency.

COIL DETAILS

The coils are wound on ¾in diameter by 2in long plastic formers which are available as standard lines from most trade houses. Fitting of the coils to the 4 pin bases is accomplished in the following manner: Drill 4 holes in the base of the former with the same spacing as the 4 pin plug. Pass the two leads from the coil through the base of the former into the two wide spaced pins of the plug and solder in place. Make up a hairpin loop of wire about 5in long and pass this down through the centre of the coil and through the remaining two holes in the base into the two close spaced pins on the socket. Pull the wire tight and solder.

In order to prevent the coil working loose with constant use, it is necessary to run a little plastic cement between the former and socket before soldering the leads in place. Note that the coils B and C should be wound as close as possible to the top of the formers so as to secure maximum coupling to the circuit under test.

Coil A, covering from 100Kc to 7Mc, consists of 145 turns of 32 gauge enamelled wire, closewound. Coil B, covering from 5 to 40Mc, consists of 17 turns closewound of 22 gauge enamelled wire. Coil C, covering from 35 to 300 Mc, consists of 3 turns closewound of

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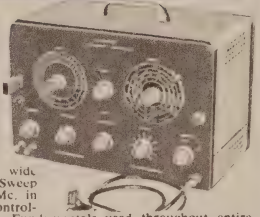

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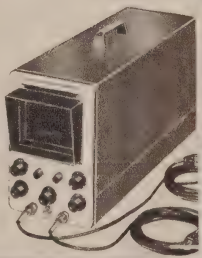

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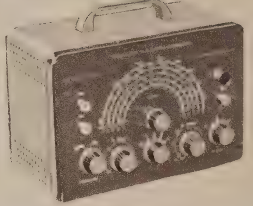

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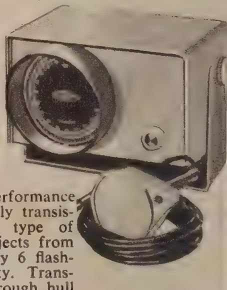

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22 gauge enamelled wire. Coil A occupies almost the entire former. Coils B and C are shorter, however, and must be wound near the top end of their formers, so that they may be placed close to the circuit under test.

Before switching on and setting the zero control, it will be necessary to plug one of the coils into the unit as otherwise an incorrect zero setting will be obtained. When this has been done, connect the unit to the generator and adjust the attenuator to give three quarter-scale deflection on the meter. You are now ready to measure the resonant frequency of that "unknown" tuned circuit.

OTHER USES

In addition to indicating the resonant frequency of tuned circuits the GDO offers a convenient means of measuring non-electrolytic capacitors. In fact a capacitor may be checked at the actual frequency at which it will be operated in equipment.

To do this it is necessary to have a good coil of high "Q" whose inductance is accurately known.

Connect the unknown capacitance across this coil and measure the resonant frequency of the combination, using the adaptor. The capacitance can be found by using the equation:

$$C = \frac{25{,}400}{F^2 \times L}$$

where F equals the resonant frequency in Mc and L equals the inductance in microhenries. The reverse of this procedure may be used to calculate inductance, using a known capacitance, when the equation becomes:

$$L = \frac{25{,}400}{F^2 \times C}$$

Yet another use for the adaptor is in the measurement of "Q" in a tuned circuit.

A rough estimation of "Q" can be obtained from the liveliness of the adaptor meter deflection when measuring resonance, a sharp dip indicating high, or fairly high, Q. However, if it is desired to go further than this, the following method may be used:

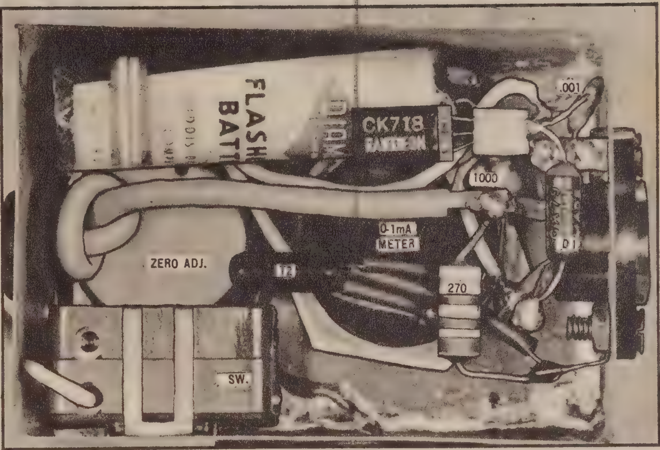
PARTS LIST

1 0-1 mA Meter 1½in Diameter.
1 SPST Toggle switch.
2 1000 ohm ½ watt resistors.
1 270 ohm ½ watt resistor.
1 10K Midget Potentiometer.
2 Transistors OC70, OC71, CK722, CK718, etc.
1 Diode Type OA79, OA81, OA85, etc.
1 Teletron 4 pin socket.
4 Teletron 4 pin plugs.
1 Pencil Torch battery type 3915.
1 Copper Case 3in x 2in x 1½in.
3 Coil formers ¾in x 2in.
Quantity of 22 and 32 gauge enamelled winding wire.

Connect a VTVM to the circuit under test as in Fig. 3, and inductively couple the circuit to the probe coil, being careful to keep the coupling constant throughout the test.

Set the VTVM to its lowest range and tune the generator to give maximum reading. Record this voltage as "E." Note the generator dial reading and record this frequency as "Fr." Now detune the generator to a higher frequency point at which the VTVM reading drops to a value of .707 of "E" and record this frequency at "F2".

VIEW OF WIRING AND LAYOUT



Internal view of the adaptor. The few components required are easily accommodated in the small case. The battery switch is at bottom left, the zero pot just above it, and the meter almost in the centre. The coil socket is at extreme right.

Next detune the generator back through "Fr" to a lower frequency point at which the VTVM reading again drops to .707 of "E," and call this frequency "F1." Calculate the Q of the test circuit by means of the following equation:

$$Q = \frac{Fr}{F1 - F2}$$

The higher the "Q" of the circuit the closer will be the frequency points "Fr," "F2" and "F1." For very high "Q" circuits, these points may be so close together that they cannot be read accurately from the generator dial.

The foregoing procedure gives the circuit Q of the entire test circuit. When it is desired to measure the Q of a coil only, connect a high-quality silvered mica or air capacitor across the coil and measure the frequency of the combination. Since the Q of such capacitors is many times that of a coil having the same resistance, the assumption may be safely made that the measured Q is that of the coil.

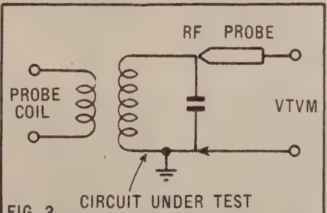


FIG. 3

A simple set-up for measuring "Q", as described in the text. A VTVM is required in addition to the adaptor.

These are just some of the uses to be found for an adaptor such as we have just described. Although the grid dip meter is, in itself, a simple instrument, many books have been written on this subject. Just how handy an instrument it is, can be found by having the use of one for a short period and then trying to make do without it!

A.O.C.P. CLASS

The W.I.A., Victorian Division, A.O.C.P. Class will commence on February 2, 1961. Morse and Regulations are held on Thursday and Theory on Monday evenings from 8 to 10 p.m. Persons desirous of being enrolled should communicate with the Secretary, W.I.A., Victorian Division, 478 Victoria Pde., East Melb. (Phone JA3535 from 10 a.m. to 4 p.m.), or the Class Manager, on either of the above evenings.

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TRANSISTORS-HOW THEY OPERATE

This is the fourth article in the series prepared by the Delco Radio Division of the General Motors Corporation. Following logically on last month's discussion on hybrid sets it discusses all-transistor sets, including portables with printed circuits.

PART FOUR

THE first step in isolating trouble in any printed circuit radio is to correlate the circuit board with the schematic diagram. Good service bulletins make this easy by showing a picture of the circuit board with numbers assigned to each conductor rail. The same number appears on the corresponding wire in the schematic and is encircled to differentiate it from other numbers on the schematic. For example (Fig. 18), if we want to check the emitter voltage of the RF transistor, a glance at the schematic tells us that we want rail number 58. We then locate rail 58 on the board drawing and put the voltmeter on that point on the board proper.

"CLICK" TEST

Since grounding the elements of transistors may cause excessive current flow and change their characteristics, there is need for a click test which permits quick isolation of trouble in a dead radio without risk of damage.

A simple solution is a 10,000 or 12,000 ohm protection resistor inserted in a test lead and one end connected to the chassis. The other end is used as a probe to shock certain test points while listening for a click. The test points where clicks should be heard are listed in service bulletins, but the following are typical.

Check Point	What to Expect
Output base	Weak click
1st audio base	Good click
1st I.F. Collector	Weak click
1st I.F. base	Weak click
Converter base	Good click
Antenna	Good click

NOTE: If clicks are heard at each point but radio is still dead, converter may not be oscillating.

This system gives a quick check for various stages in dead radios because no noise pulse, or click, will be passed by a dead stage. For example, if a click is heard at the 1st audio base but not in the 1st IF or converter stages, voltages should be checked in the IF stages as the signal is being blocked there. As a word of caution, however, never start any isolation procedure without first checking the battery voltage. This should always be the first step in any battery operated portable, regardless of how the radio sounds. Then turn the volume control to maximum before starting the "click" test.

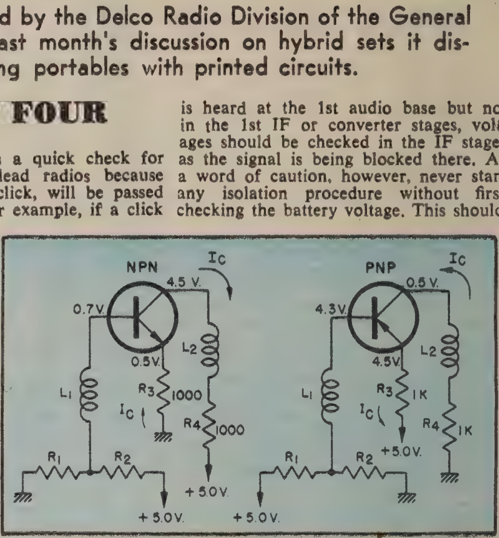

FIG. 21: *Typical transistor amplifier stages using NPN and PNP type transistors. Voltages shown are on the basis of each transistor drawing .5 mA. Note particularly the voltage divider R1-R2 supplying base bias.*

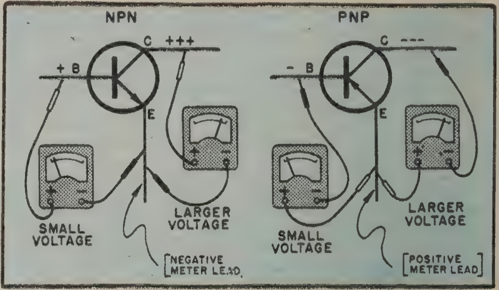

FIG. 22: *Using a sensitive voltmeter, measurement of base and collector voltages will often reveal a fault. Diagram shows typical measurements in both PNP and NPN types. Note the difference in polarity.*

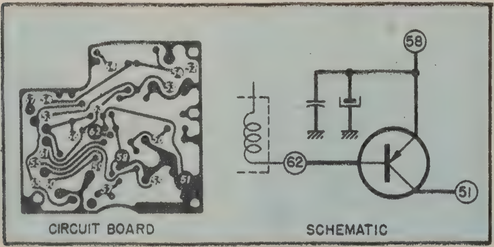

FIG. 18: *A typical example of manufacturers' service data, showing how numbers are used to correlate the schematic diagram. Such information is most valuable when dealing with unfamiliar printed wiring boards.*

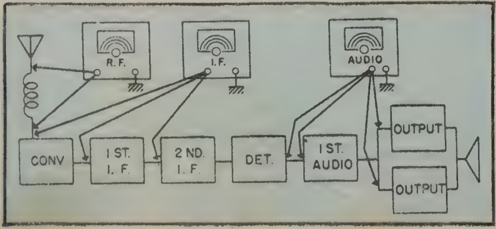

FIG. 20: *Finding a fault in transistor set by means of a signal generator. Appropriate frequency signals are fed into various stages and the output noted. A capacitor should be inserted in series with the generator lead.*

The signal generator is a valuable service instrument, not only for alignment when required, but also for isolating a weak stage in the radio. Important things to remember when using a signal generator are to select the proper frequency —audio, IF or RF—and to keep the generator output as low as possible. This will prevent misleading indications since transistors have a tendency to be "blocked" easier than valves when overloaded. So, always start with a low gain setting and work up to minimise blocking. The volume control of the radio should always be maximum and a .1 mfd isolation capacitor used in series with the probe lead of the generator.

The signal generator generates a signal which can be injected at various points in the radio. In this case we begin at the audio end and work towards the antenna, and where the signal disappears or becomes weak, trouble is suspected.

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* **Inquiries re Delco power transistors should be directed to National Automotive Service Co., Box 162 P.O., Dandenong, Vic.**

It is important that the volume control on the radio be turned to maximum. The first check point can be the base of the output transistors, and some audio should be heard here if the output stage, speaker transformer, and speaker are functioning. A louder signal will be heard at the base of the 1st audio transistor, because one additional stage has been added between the signal injection point and the speaker.

I.F. TEST

The last audio test point is at the detector diode, where the same strong signal should be heard if the volume control is intact and set to maximum.

The signal generator is then switched to the radio's IF and applied to the base element of the IF stage nearest the speaker. At this point it is handy to know what settings on your signal generator are required to obtain a given output at the speaker, say .5 volt. This is easily determined by trying it on several typical good radios when they are in the shop, and recording the settings. The output is read as an AC voltage across the speaker.

If the radio is normal at this point, reduce the generator output until a weak signal is heard. This sets up a reference again for moving the probe to the 1st IF base and listening for a gain there. This procedure should be carried out, step by step, until the antena is reached. Re-

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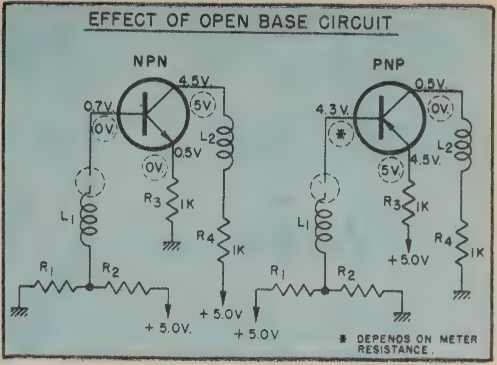

FIG. 23: *A failure in the base circuit will remove the base bias and the transistor will no longer conduct. The results, in terms of voltages, are shown in the dotted circles. The normal voltages also are shown.*

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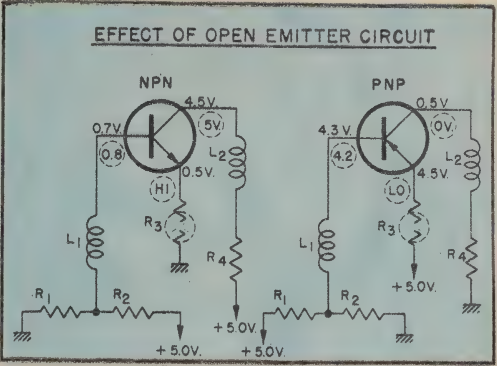

FIG. 24: *Voltage behaviour when an emitter circuit opens. No collector current will flow and there will be no voltage across R4. Element voltages will change slightly as shown.*

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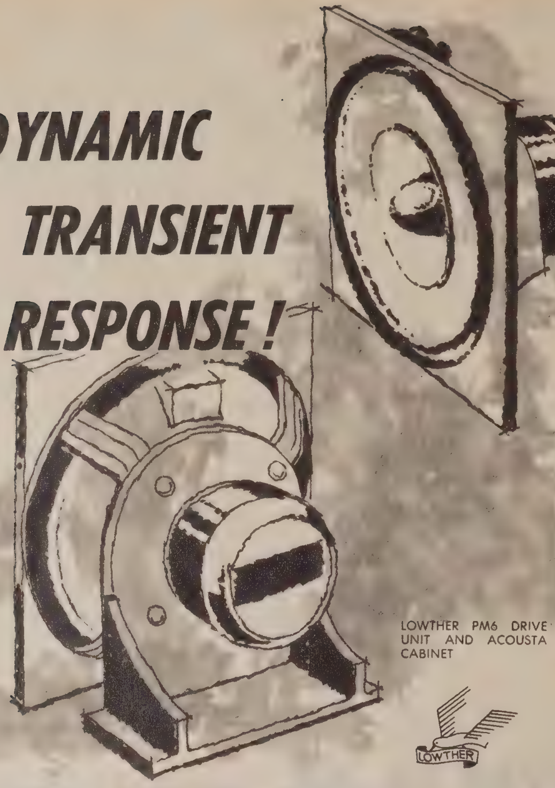

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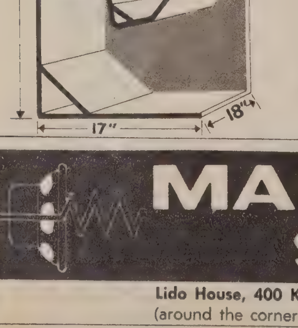

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MASTER SOUND

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member to change from IF to RF output from the generator before checking the RF stage or antenna.

Another service instrument to consider is the signal tracer.

The signal tracer can monitor a radio station signal at various points throughout the radio. It is very useful for determining in what stage distortion or loss is occurring. The signal tracer may be simply an audio amplifier with self-contained speaker and a diode probe in the lead when switched to the RF position.

SIMPLE TRACERS

Such simple signal tracers—often designed on the basis of valve type receiver servicing—may not always be satisfactory in transistor servicing. Due to the low impedance of transistor circuits, signal voltages will be lower and it may be difficult to hear any signals in the front end of a portable, including RF and converter stages. However, the signal probably will be picked up somewhere in the IF stages if the "front end" is working normally, and can be heard at the collector elements of the 2nd IF and audio stages if they are normal.

(Editorial Note: More elaborate signal tracers are much more sensitive, and should be able to pick out a signal at any point right up to the aerial terminal; assuming reasonable signals from a nearby broadcast station.)

After an idea is obtained as to the general area or stage in which the trouble is located, voltages should be read and compared to the schematic. The first check made on any portable is always the batteries, which should reveal a battery voltage within 10 p.c. of normal. (If not near normal, batteries should have been changed before any checks were made.) This should put all the transistor element voltages within about 10 or 15 p.c. of normal for those over 1 volt and plus or minus .1 or .2 volt for those under 1 volt.

The voltages in the suspected stage and on each side of the suspected stage should be checked. In most cases, a 20,000 ohm per volt VOM is just as satisfactory as a VTVM and eliminates the chance of error due to failure to "zero" the meter.

VOLTAGES

Figure 21 has basic NPN and PNP circuits. In both cases, the base is tied to a simple two-resistor voltage divider, R1 and R2. This keeps the base voltage almost constant unless something happens to the circuit between this divider and the transistor base terminal.

The emitter and collector voltages will vary with the amount of collector current, Ic, flowing in the collector circuit. This is because the collector current, in completing its path through the transistor and the batteries, has to flow through R3 and R4.

The only difference between the NPN and PNP circuits shown here is that the battery polarities are reversed so that electrons flow in the opposite direction (see arrows). Both transistors are drawing .5 milliamperes of current, because the current is producing a voltage drop of .5 of a volt across R3, and .5 of a volt across R4. By Ohm's Law, we can show that Ic equals E/R, or Ic equals

.5V/1000 ohms, equals. .0005 amp or .5mA.

This is why there is a half-volt difference between the emitter voltage and ground in the NPN circuit. If no collector current were flowing, the emitter of the NPN transistor would be zero and the emitter of the PNP transistor would be the full 5.0 volts, with no drop. The amount of voltage drop depends on the amount of current and the resistor values in emitter and collector circuits.

It should be remembered that, in NPN transistor circuits, the most negative or least positive element is the emitter. So, if the negative lead of a voltmeter is placed on the emitter for a reference point, Fig. 22, the base should show a slight positive voltage which is the bias voltage for the transistor. This usually runs between .1 and .3 volts. Then, when the positive meter lead is moved to the collector, a larger positive voltage should be measured.

In PNP circuits, the most positive element is usually the emitter. So, if the positive meter lead is placed on the emitter for reference, a small voltage will be noted at the base and a larger voltage at the collector. The exception to these rules is found in some converter circuits, where the oscillator may normally cause no voltage between base and emitter, or even a reversed voltage from the usual polarity.

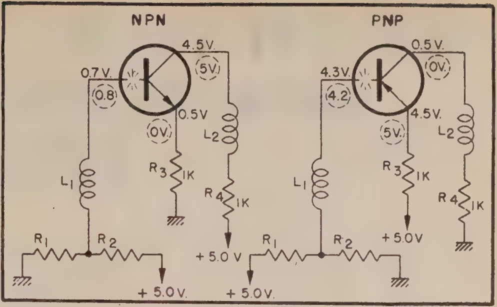

FIG. 26:
An internal open base condition will cause lack of collector current, even though base bias appears almost normal. Changes in collector and emitter voltages provide the clue.

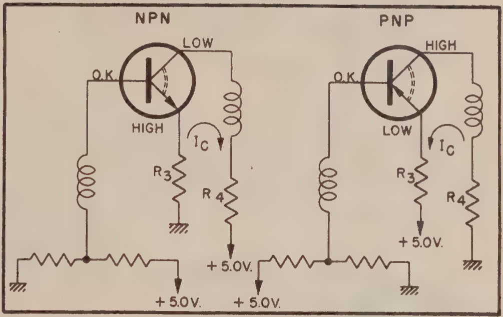

FIG. 27:
Another internal fault, a partial short between collector and emitter. Again the base voltage is near normal with abnormal base and collector voltages. Note the difference between NPN and PNP circuits.

LOSS OF BIAS

If, as in Fig. 23, a connection in the base circuit should open, or the base transformer opens, the base voltage changes because it loses its connection to the voltage divider R1-R2 which normally sets the base voltage. This causes the base-to-emitter difference, or bias to disappear and the transistor stops conducting. Note that normal voltages are still shown but approximate voltages which occur with the defect are encircled.

In the NPN circuit, when the collector current stops, the emitter voltage drops because no appreciable current will be flowing through the emitter resistor R3. Also, since collector current is no longer flowing through collector resistor R4, there is no voltage dropped across R4 and the collector voltage rises. In this case, because the base voltage which is normally set by a voltage divider is far from normal, we are led to check for trouble in the base circuit.

In the PNP circuit, Fig. 23, the base is again floating and disconnected from its voltage divider source. This causes a loss of bias (base-emitter difference) when measured between base and emitter elements. The reason for this phenomenon is that the transistor has a low internal resistance between base and emitter, and the floating base element will go to the potential of the emitter. However, when measured from base to ground, it may drop a little due to the meter resistance giving it a path to ground; this is true when a VOM is used. But the improper base voltage still leads us to suspect trouble in the base circuit. The emitter and collector voltages again reflect the fact that the collector current has stopped flowing through R3 and R4.

LEAKAGE

Actually in both circuits, of Fig. 23, the emitter and collector voltages may vary slightly from these values due to a small amount of "leakage" current which normally flows between emitter and collector when the base is open circuited.

With an open emitter circuit, shown in Fig. 24, the stage will be dead, the base voltage will be fairly close to normal, but emitter and collector voltages will change slightly. Collector current will stop flowing because its path is broken, and no voltage will be dropped across R4 due to the absence of current through it.

Let's first examine the NPN circuit, Fig. 24. Collector voltage is the full "A" voltage because no collector current is flowing through R4. The emitter, being a floating element, takes on the adjacent base voltage due to the low internal resistance inside the transistor. Since base voltage is near normal, we eliminate it as a probable cause of trouble, and quick checks of resistance in the emitter circuit will uncover our trouble. The improper emitter-to-base relationship leads us to suspect trouble in the emitter circuit rather than the collector circuit.

In the PNP stage, Fig. 24, the lack of collector current flow through R4 causes no voltage drop across it, and the collector voltage goes to ground potential. The floating emitter again assumes the base voltage which is about 4.2 in this case. Normally, the emitter should be slightly more positive than the base in a PNP circuit. Again, the presence of a fairly normal base voltage but incorrect emitter and collector voltages leads us to look for a bad connection or defective component in the emitter or collector circuit. No forward bias between base and emitter, in conjunction with a fairly normal base voltage, points to trouble in the emitter circuit.

OPEN COLLECTOR

Fig. 25 shows an open in the collector circuit where the collector element is floating and all collector current ceases. The previously insignificant base current, Ib now attracts more of the emitter electrons, keeping some current flowing through emitter resistor R3.

In the NPN circuit, the base and emitter voltages remain fairly normal but the floating collector element drops considerably to assume the emitter voltage. This tips us off that something is wrong in the collector circuit, because the relationship between emitter and collector elements is zero instead of normal.

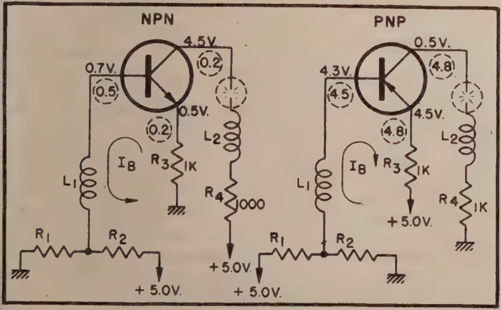

FIG. 25:
When the collector circuit opens the best indication is a lack of voltage between collector and emitter. There will be an increase in base current and some voltage still developed across R3.

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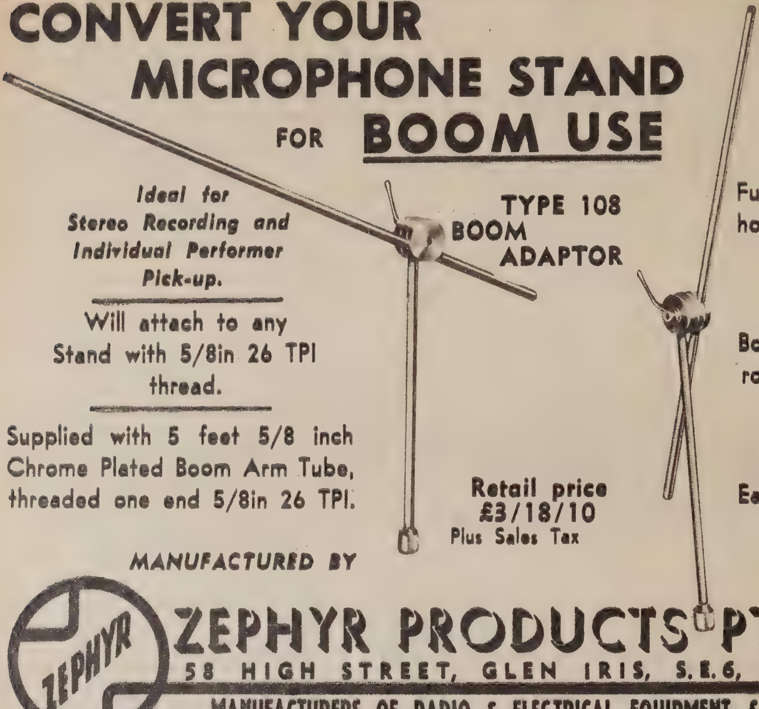

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In the PNP circuit, the base and emitter also remain close to normal and the open collector element swings up to the emitter voltage. The far from normal collector voltage tips us off to trouble in the collector circuit.

A defect in the transistor will also disturb the transistor voltages in most cases. For example, if the base lead opens internally, Fig. 26, the base voltage will measure fairly normal due to the fixed base voltage supplied by the base voltage divider. However, emitter and collector voltages will be off due to the lack of collector current.

FLOATING BASE

In the NPN circuit, Fig. 26, the floating base in the transistor causes the transistor to practically cease conducting, except for a small leakage current, and the emitter drops from several tenths of a volt to a point near ground or zero volts. The collector, with no current through collector resistor R4, goes up to a point near the source voltage of 5 volts.

Both the emitter and collector voltages give evidence that the transistor is drawing no collector current, even though there is more than ample forward bias (.8 volt) between base and emitter. This leads to the belief that something must be wrong in the transistor itself, otherwise it would be conducting.

In the PNP circuit, Fig. 26, the open base also causes a reduction in collector current, but the base measures close to normal voltage due to its unchanged divider. The absence of normal collector current through R3 and R4 reduces the amount of voltage across these resistors so that the emitter goes to nearly source voltage (5 volts) and the collector drops to a point near zero.

Again, the proper relationship of voltages and bias makes it apparent that the transistor should be conducting, but the lack of proper voltage across R3 and R4 shows that it is not. A "diode" check of the transistor itself, with an ohmmeter, is in order whenever the biases between elements are normal but the transistor does not draw proper collector current.

HEAVY CURRENT

When transistors become leaky between emitter and collector, as has happened in Fig. 27, base voltage remains constant but the transistor conducts very heavy current through the emitter and collector circuits.

When leakage develops in the NPN transistor, the increased collector current, Ic, produces larger than normal voltage across emitter resistor R3, causing the emitter voltage to rise. In fact, the emitter voltage may go several tenths of a volt above the base voltage, placing reversed bias on the transistor and cutting off all signal current in the base circuit. This will cause a dead stage. The collector voltage drops due to the high leakage current flowing through R4, except in circuits where no collector resistor is present.

In the PNP circuit with leakage, the base voltage remains fairly normal but the emitter voltage drops and the collector voltage increases due to the excessive current through R3 and R4. If no

(Continued on Page 111)

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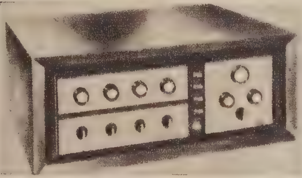

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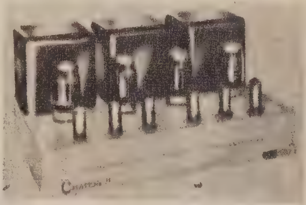

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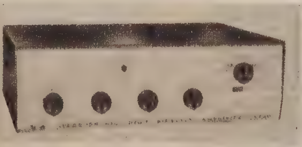

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7/6 ea. £4/-/- doz.

Let's Buy An Argument

In his letter, in the panel opposite, a reader from Kilburn, South Australia, poses a couple of questions which are nicely weighted for inclusion in these columns. They won't be over the heads of our younger readers but they can still prompt discussion among those who like to dig a little deeper into things.

by Neville Williams

I SUGGEST you read the letter at this juncture.

His first question concerns the cathode bypass capacitor for the output valve. Why do we include this component when most others do not?

To begin with, I can only accept on face value the inference that inclusion of the capacitor is the exception rather than the rule. Since we neither file commercial circuits nor handle commercial receivers, in our office laboratory, I have no immediate means of telling whether the claim is, in fact, correct.

PURPOSE OF CAPACITOR

It could be, so let's leave it at that.

The purpose of the cathode bypass capacitor is to minimise the signal voltage generated across the cathode bias resistor by the passage of signal-modulated plate and screen current.

By so minimising signal at the cathode pin, the valve (or valves) concerned operate in closest conformity with their published dynamic characteristics. Our correspondent obviously has single valve operation in mind, so let's confine our thinking initially to that.

If included, the bypass capacitor should have a value such that its reactance is lower than the value of the bias resistor over the whole range of frequencies which the stage is required to reproduce. That is why a large value electrolytic capacitor is invariably specified, 25mfd. being the most common choice.

If the capacitor is omitted, the signal modulated plate and screen current develop signal voltage across the cathode bias resistor.

A positive-going signal at the grid causes an increase in plate and screen current, which produces a positive-going signal at the cathode. Since this is in phase with the original signal on the grid, it has the effect of making smaller the difference between the instantaneous grid and cathode voltages.

And because this difference is the actual, effective grid signal, we are simply saying that having the cathode resistor unbypassed makes the input signal appear smaller than it really is.

Because the interacting voltage is produced by the valve's output current, it qualifies as a **feedback** circuit and, since it reduces apparent stage gain, it qualifies as **negative feedback.** In practice, the gain reduction usually works out at about 2:1, or 6db.

LOGICAL COURSE?

It may seem from this that omission of the cathode bypass is a natural and logical course to follow. It saves a component and it applies a certain amount of negative feedback, which should ensure lower distortion. However the sequence isn't quite as automatic as that.

In receivers having a single audio stage following a diode detector, there is seldom any gain to spare and a further 2:1 reduction may be quite unacceptable, whatever benefits there may be in other directions. Where there is any thought of operating such a limited audio system with a pickup, the remark would have all the more force.

There is a special point of note also about the kind of feedback provided by omission of the cathode bypass. It is negative, to be sure, but the voltage developed across the resistor is proportional to the **current through** the output load, not the **voltage across** the load.

In other words, it is **current negative** feedback.

If the output load were purely resistive, there wouldn't be any difference between the two, because current and voltage are directly related in a resistance by Ohm's Law.

HIGHLY REACTIVE

But the load, in the case of an output valve, is the highly reactive loudspeaker and its impedance is both complex and variable. It gives a different result when fed from systems which tend to maintain constant **current through** the load, as compared with those which tend to maintain constant **voltage across** it.

Most loudspeakers exhibit a rising impedance characteristic with increasing frequency, at least above a few hundred cycles.

With a constant current system, th

current tends to keep pace with the rising impedance and to maintain the power fed to the speaker.

With a constant voltage system, power fed to the speaker diminishes as the impedance rises with frequency.

This would seem to suggest, automatically, that loudspeakers should be fed from a constant current system—that is from an output stage having a high internal impedance and preferably incorporating current feedback.

The trouble is that, where loudspeaker response curves are published at all, they appear to be given on the basis of constant voltage feed; that is from an output stage having low effective impedance and, as a rule, using negative voltage feedback.

And, as far as high fidelity speakers are concerned, if that is the way their manufacturers intend them to be used —and so design them—we must accept them on that basis.

CHEAPER EQUIPMENT

In the realm of cheaper equipment, where the end tends the more to justify the means, it generally boils down to this: If negative voltage feedback is used, the output system tends to low output impedance and constant voltage characteristic, with restrained or diminishing treble response; please yourself which adjective you choose.

If a pentode is used with no feedback, the output system tends to high impedance and constant current, with a more prominent or sustained treble response. Adding negative current feedback accentuates the tendency.

The latter therefore tends to sound brighter. This can be an advantage if too much treble response has been lost en route through the tuner. It can be a disadvantage with pickup reproduction, particularly if the pickup is rather light-on in the bass end and endowed with a too-noticeable treble peak.

Nor is that the end of the tale. Since harmonics are at a higher frequency than the fundamental, they tend to be accentuated relative to the fundamental in a system with a rising impedance characteristic. It therefore becomes highly questionable whether, in the overall picture, negative current feedback does confer the expected benefits in relation to harmonic distortion.

INTERNAL IMPEDANCE

And at the bass end, an output stage with high internal impedance is generally agreed to be undesirable, since it cannot impose any worthwhile control over the loudspeaker cone. Without this control, and assuming that the baffling is only mediocre, the cone tends to accentuate frequencies in the region of its own natural resonance.

So the choice seems to be this: Brighter treble with a tendency to higher harmonic distortion and "boompy" bass or restrained treble with a tendency to reduced distortion and better controlled bass.

Some may observe, of course, that removal or addition of the capacitor seems to make very little difference and this certainly could be true of audio systems having another deliberate negative voltage feedback path. This latter would simply take up most of the difference which the bypass could make.

But, in so doing, the potential of the feedback system to deal with inherent distortions would be restricted and its effect of reducing output impedance partly offset. There may actually be differences, though not immediately apparent.

Again, in the case of class AB1 push-pull amplifiers, the cathode bypass capacitor, while not having much effect on gain, can have a marked effect on peak power output. It may not be so obvious on casual listening tests but it can show up quite plainly, in some cases, on instruments.

IS IT IMPORTANT?

But is it really important if you can't hear it?

Personally, I'm very wary of dismissing effects which you can see on instruments but "can't hear in practice."

Good or bad sound reproduction can result from the accumulation of many things that are better or worse, each in themselves of no great magnitude. The cathode bypass can be one of them.

In saying all this. I haven't been quantitative and I haven't given a verdict one way or the other. One couldn't say yes or no, anyway, without a lot of qualifications. But what I have said will have been sufficient to show that there are quite a few factors to be considered.

J.W's. second question relates to the amount of feedback which we customarily specify for our audio amplifiers. His experience has been that he can often greatly increase the amount of feedback, while still retaining adequate gain.

But he does note an apparent improvement in tonal quality.

I have two basic observations to make about this.

Firstly, our circuits have to be designed so that there will always be a

WHY USE A CATHODE BYPASS?

As a rank amateur, I am probably sticking my neck out in raising this question, but it is increasingly bothering me.

In all your excellent receiver circuits you show the output valve cathode resistor by-passed to chassis with an electrolytic capacitor, yet how many commercial designs use this "refinement?"

Numerous friends, knowing my interests, have called me in to look at "sick" radios, and this bypass capacitor, I find, has been the exception rather than the rule.

Also, I have put together many of your circuits just for the fun of it, and I note that the omission of this by-pass usually provides a slight, but noticeable improvement in tone "sharpness." This is particularly so with the more recent 6BM8 circuits.

I realise that with commercial sets it is as much a matter of cheapness as anything, but why not utilise the anode-cathode, cathode-grid interaction of the common cathode resistor to provide a useful amount of degeneration?

Another point: are you not overcautious in your application of feedback? Of course, I have not made the calculations of amplification, gain, cut-offs, etc. (I would not be capable of it, anyway), which I suppose you have, but as a practical test I have as much as doubled, and even tripled, the amount of feedback without any signs of instability, and with a noticeable improvement in tone.

The gain in your latest circuits is so ample that nobody who is not stone deaf could stay in the same house (repeat house) with a set whose volume control is turned more than half way up.

So why not sacrifice some of this terrific gain to get a better tone?

As I say, these are but the ramblings of a rank amateur. Is there an answer that will not show up my lack of knowledge too much?

Yours faithfully, J. W. (Kilburn, S.A.

DECIMAL CURRENCY, &c.

I was very interested in a letter by L.C.D. in the December issue of R. TV & H regarding a duodecimal system of counting.

Our use of a decimal system stems from the unfortunate fact that Mother Nature blessed (?) mankind with ten fingers. As a result, I cannot see us changing our present system, which is a pity.

Of course, if we did institute a duo-decimal system, it would be a wonderful chance to rationalise our system of physical units.

For example, the CGS system could become the Nul, Num and Nut system, meaning the new unit of Length, Mass and Time.

The absolute standard would be the Nut, which would equal L over the fifth power of twelve or 1/248,832 mean solar day.

The Nul would be based upon the standard acceleration due to gravity, so that G equals 144 (written 100 and pronounced "one gross") of Nuts per Nut squared!

The Num would be the mass of one cubic Nul of water at 4 degrees centigrade. I feel sure that this system would make SOMEONE'S calculations much easier.

Seriously, though, our weights and measures and monetary systems have grown up through everyday practical use and many units are still useful.

Another point is that, with decimal currency, dozens are useless. Therefore goods will be packed in units of 10, which in general make oddly shaped packages, needing more material per unit than dozen boxes.

Yours faithfully, D.L.P.

★ The WARBURTON FRANKI Page ★

WORLD'S FINEST SILICON ZENER VOLTAGE REGULATOR DIODES

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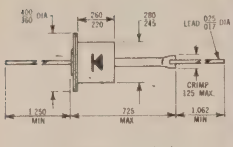
1 WATT RATED TYPES

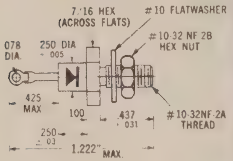

400/360 DIA
260/220
280/245
LEAD 025/017 DIA
CRIMP 125 MAX.
1 250 MIN
725 MAX
1.062 MIN

All dimensions in inches

Ratings and Characteristics at 25°C Ambient

JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	@ Iz ma.	TYPICAL DYNAMIC RESISTANCE Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
1N1518	1Z 3.9	3.6-4.3	50	9	250	-.04
1N1519	1Z 4.7	4.3-5.1	40	8.5	200	0
1N1520	1Z 5.6	5.1-6.2	35	5.5	175	+.03
1N1521	1Z 6.8	6.2-7.5	30	1.6	150	+.05
1N1522	1Z 8.2	7.5-9.1	25	1.1	120	+.06
1N1523	1Z 10	9.1-11	20	1.5	100	+.07
1N1524	1Z 12	11-13	15	2.4	80	+.075
1N1525	1Z 15	13-16	13	5.4	65	+.08
1N1526	1Z 18	16-20	10	11	55	+.085
1N1527	1Z 22	20-24	9	18	45	+.09
1N1528	1Z 27	24-30	7	28	35	+.095

3.5 WATT RATED TYPES

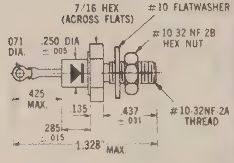

7/16 HEX (ACROSS FLATS)
#10 FLATWASHER
#10-32 NF 2B HEX NUT
078 DIA.
250 DIA ± 005
425 MAX
100
.437 ± 031
#10-32NF-2A THREAD
250 ± 03
1.222" MAX.

All dimensions in inches

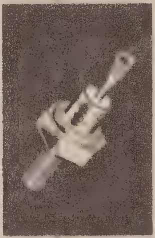
RATINGS AND TYPICAL CHARACTERISTICS

JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	@ Iz ma.	TYPICAL DYNAMIC RESISTANCE Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
IN1588	3Z 3.9	3.6-4.3	150	2.6	850	—.04
IN1589	3Z 4.7	4.3-5.1	125	2.3	700	0
IN1590	3Z 5.6	5.1-6.2	110	1.4	625	+.03
IN1591	3Z 6.8	6.2-7.5	100	.58	525	+.05
IN1592	3Z 8.2	7.5-9.1	80	.5	425	+.06
IN1593	3Z 10	9.1-11	70	.7	350	+.07
IN1594	3Z 12	11-13	50	1.4	275	+.075
IN1595	3Z 15	13-16	40	3.4	225	+.08
IN1596	3Z 18	16-20	35	6	200	+.085
IN1597	3Z 22	20-24	30	9	160	+.09
IN1598	3Z 27	24-30	25	13	125	+.095

10 WATT RATED TYPES


7/16 HEX (ACROSS FLATS)
#10 FLATWASHER
#10 32 NF 2B HEX NUT
071 DIA.
.250 DIA ± 005
425 MAX.
.135
.437 ± .031
#10-32NF-2A THREAD
285 ± 015
1.328" MAX.

All dimensions in inches



RATINGS AND TYPICAL CHARACTERISTICS

JETEC TYPE	INT'L TYPE	ZENER VOLTAGE RANGE VOLTS	@ Iz ma.	TYPICAL DYNAMIC RESISTANCE Zz (OHMS)	Iz MAX.	NOMINAL TEMP. COEFFICIENT %/°C
IN1599	10Z 3.9	3.6-4.3	500	.84	2500	—.04
IN1600	10Z 4.7	4.3-5.1	400	.68	2000	0
IN1601	10Z 5.6	5.1-6.2	350	.3	1750	+.03
IN1602	10Z 6.8	6.2-7.5	300	.2	1500	+.05
IN1603	10Z 8.2	7.5-9.1	250	.25	1200	+.06
IN1604	10Z 10	9.1-11	200	.55	1000	+.07
IN1605	10Z 12	11-13	170	.95	850	+.075
IN1606	10Z 15	13-16	140	1.5	650	+.08
IN1607	10Z 18	16-20	110	2	550	+.085
IN1608	10Z 22	20-24	90	3	450	+.09
IN1609	10Z 27	24-30	70	4.5	350	+.095

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ALL STANDARD TYPES AS LISTED AVAILABLE FROM STOCK

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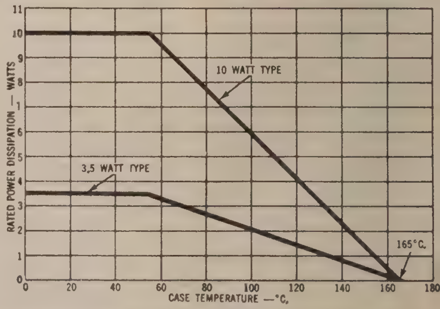
Derating of Power Dissipation vs. Case Temperature 3.5 watt and 10 watt Series.



WARBURTON FRANKI

VIC.—355 LONSDALE ST., MELB., 67-8351 ● N.S.W.—307 KENT ST., SYDNEY, BX1111.
QLD.—233 ELIZABETH ST., BRISBANE, 31-2081.

nargin of gain to cater for the inevitble cases where the tolerances all hapen to be the wrong way; where the ickup output is on the low side, where ecord grooves are not as deeply moduated as they might be, where speaker ensitivity may be down and where the ser wants high volume.

Inevitably and by converse, there will e cases where the margin of gain apears to be higher than is strictly necesary, so there is nothing surprising in .W's. remarks.

Gain is usually more of a problem n "economy" designs, where a valve ke the 6BM8 may well be featured. In uch designs, the amount of feedback nay well be specified with an eye to reserving a margin of gain, rather than pplying the largest amount of feedback vhich could otherwise be arranged.

Where it subsequently transpires that here is gain to spare, it is reasonable to onsider applying more feedback, and to ealise any benefit that may stem therefrom.

But, of course, it is also necessary to emember that "economy" designs may lso involve economy output transformrs which could give trouble at lesser rders of feedback than the more exensive types.

Although one always has to keep an ye on the gain, it is usually less of a roblem in more elaborate equipments, nd the designer may be free to use as nuch feedback as he feels inclined.

Some designers have felt inclined to se 30 decibels or more of feedback, ome considerably less.

Naturally enough, we have given the natter a good deal of thought in conection with our "Playmaster" series of mplifiers and elected, quite deliberately, o use not more than about 20 decibels f feedback in any design intended for ome construction.

Our feeling is simply that the use of nis order of feedback realises most of ne potential benefit of the system. The eturns for using feedback over and bove this become progressively smaller.

ORE CRITICAL

On the other hand additional feedback nakes the amplifier more and more critical, both of its own components and of s "environs."

In a factory-built amplifier, where lose control can be maintained over the omponents, it is practical to design for somewhat higher order of feedback. n one to be home-constructed, using variety of parts and wiring techniques, is generally better in our opinion, to be nservative.

Unless I miss my guess, there are a w designers of commercial amplifiers, ho probably wish they had also been nservative. Several I have come across e very prone to instability, if connected input or output circuits having just a tle too much capacitive reactance.

Most amplifiers can be forced into osllation, if taken to extremes, but these ould go off at the drop of a hat.

So, as I said, we've chosen to be conrvative and very glad of it, too.

But I have reservations about our rrespondent's assertion and apparent sumption that more feedback autoatically makes the amplifiers sound tter.

One does not have to go very far ong the line in amplifier design before e electrical performance rises well ove that of the signal source and the producing loudspeaker, so that these rather than the amplifier set the limit on the sound quality of the system.

My impression is that one would need good associated equipment and a very keen ear to pick the difference due to increasing the feedback over and above the usual 12 to 20db. specified in the majority of our amplifiers.

Lastly, do I detect some inconsistency in the two sections of this letter? At the outset, our correspondent recommends a course which can only increase the internal impedance of the output stage and produce a rising treble response. In the second part, he counsels using more negative voltage feedback which, if anything, will have the reverse effect.

AC GENERATORS

As a change from amplifiers and all that, I quote a letter from a reader in New Lambton, N.S.W.:

"Dear Sir,

Recently a friend and I were discussing the generation and transmission of electricity. This was inspired by an article in your June issue.

"The problem we can't solve is that of two generators working out of phase. Would not their outputs cancel? Even a slight deviation from exact phase correspondence would seemingly make this happen.

"My thoughts were that, in such a situation, the voltage all along the line would be zero. Hence at the generator, the voltage would be zero, despite the fact that its rotor may be in a position to generate voltage.

"Thus a magnetic field would be set up, opposing the motion of the rotor until such time as equilibrium was set up. Wouldn't this take only a fraction of a second?

"Is this assumption true? If not, what does happen?

"Yours faithfully, J.C."

Reading this letter reminded me of an episode, many years ago, before the present extensive power reticulation system had been set up.

"Marooned" overnight in a country town, I went searching for the source of noises which I reckoned might be coming from the local power station.

It transpired that the noise did come from the power station and that the engineer in charge was just about as lonely as I was. He was very happy to show me the metering, the switching, the equipment in operation and the standby gear, ready to take up some of the load.

In due course, I got around to asking about how this extra generating equipment was brought into operation. Didn't it have to be phased before closing the switch. How careful did they have to be or could they just slap the switch across and let it sort itself out?

I was left in no doubt that his equipment, anyway, would not "sort itself out"!

He made the point that, to close the switches at random, might find the circuits at quite dissimilar voltage conditions, resulting in a virtual short circuit, with resulting flame, fire and confusion.

It was essential to bring the auxiliary generator up to frequency, wait for the instant when the circuits had drifted into phase, then throw the big switch. After that, they would hold synchronism automatically.

R. H. Oxford & Son Pty. Ltd.

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R. and H. Voltage Supply Regulator. case, chassis and printed panel. £4/17/6. plus 12½ p.c. tax.

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R. and H. 3in Service C.R.O. case, chassis and printed panel, Sept. 1960. £7/10/-.

R. and H. Audio Square Generator, April-May, 1960. £3/18/6. Case, chassis, and printed panel.

R. and H. Sweep Generator, May, 1960. £3/4/6. Case, chassis, and printed panel.

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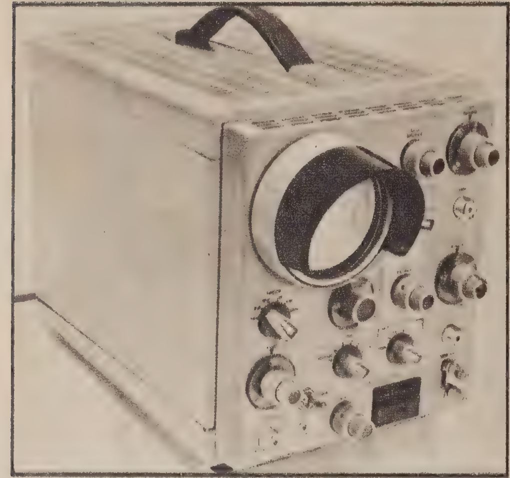
Sydney. 69-3764, 69-3829.

TRADE REVIEWS AND RELEASES

SOLARTRON—COMPACT, WIDE BAND OSCILLOSCOPE

The Solartron type CD1014 is a true double-beam instrument, incorporating a 3in flat-faced two-gun cathode ray tube. Incorporating high performance amplifiers, time bases, etc., it is still light enough (22lb) and small enough to justify its rating as a portable.



FITTED with two completely independent Y amplifiers, the voltage calibrations of the instrument are accurate to within 5 per cent. Both Y ampliers are DC coupled and have a response which is 3dB down at 5 Mc/s. Sensitivity is from 100 v/cm to 100 mV/cm on both, with an extra preamp on one amplifier giving sensitivities of 10 mV/cm and 1 mV/cm for low-level audio work.

Input impedance of both Y amplifiers is 1 megohm and 20 pF. and a link is provided on the front panel to isolate the Y amplifiers from earth. Allowed floating voltage is 500 DC, with maximum input of 500 volts peak for each amplifier.

The time base circuit is a "bootstrap" type, having calibrated speeds ranging from 1 sec/cm to 1 micro sec/cm. A calibrated expansion control allows calibrated speeds of up to 0.2 micro sec/cm to be used.

Triggering is possible from positive or negative-going signals either internally or externally. The trigger level can be set on any point on the triggering waveform, the control range being plus or minus 2.5 volts either side of the mean signal level.

On test in our laboratory this instrument performed remarkably well, the timebase triggering very readily and being quite stable. Shift controls give plenty of shift, enabling even expanded patterns to be examined fully.

Due to the care which has obviously been taken in the design, the unit is very convenient to use. It should be a credit to any laboratory or service shop.

Price of the instrument is quoted a £170 nett, including sales tax, and al inquiries should be directed to the loca representatives, Ronald J. Payne Pty Ltd., 385-389 Bridge Road, Richmond Victoria. (J.R.)

MULTIPLE TV OUTLET COUPLERS

R. H. Cunningham Pty. Ltd., announce the availability of an extremely simple, but nevertheless efficient, coupling unit designed to allow several TV sets to be operated from a single aerial. The unit (illustrated) is known as the ML300 Electro Magnetic TV Set Coupler.

Moulded from high grade insulating material, it is designed to clamp directly on to a standard 300 ohm feeder line—without any cutting or splicing—and to provide a suitable order of coupling for an extra receiver.

It is claimed that, in good signal strength areas, as many as 20 receivers may be operated from a single aerial without an amplifier. Where signal strength is insufficient, the "Cunningham" 189 TV distribution amplifier (reviewed last month) may be used to provide the required boost.

Further details may be obtained from R. H. Cunningham Pty. Ltd., 8 Bronham Place, Richmond E.1 Vic., or 29 Gibbes Street, Chatswood, N.S.W. (Branches in other capital cities).

TV FM
Cunningham
COMPONENTS

AKG MICROPHONE

Readers wanting a professional quality microphone will be interested in one of the "AKG" brand recently submitted for review.

KNOWN as the D19B, it is an attractive moving coil unit suitable fo hand. desk, or stand use. Made in Austria by Akustische U. Kino-Gerat GMBH, it is now readily available i this country.

Tested on speech and music in ou own laboratory it gave a very impressiv performance, and we have no doubt tha the makers' claims that it is of broadcas standard are fully justified. Response i given as 40 to 16,000 cps and is notabl smooth.

The D19B in attractive desk stand.

In spite of its high performance, i is a moderately priced unit, and woul appear to be an ideal choice for anyon wanting something substantially bette than the average "tape" or "PA" microphone. It should be the logical "nex step" for the enthusiast who has trie most of the cheaper varieties and foun them below the standard required.

The D19B has already found wid application in advanced amateur recording equipment and as announcer microphones in broadcast and TV studios.

This microphone is one of a very larg range now available, including to quality professional units, and it is hope to review other models from time t time in the next few months. Also included in the range are the stereo headphones discussed elsewhere in this issue.

Retail price of the D19B is £25/10/ and of the headphones £11/18/6. Further details and technical specification may be obtained from the Australia distributors, Electronic Parts Pty. Ltd. 206 Broadway, Sydney.

"EMPIRE 108" STEREO HEAD

Pictured below, in its stylish casket, is the Empire 108 stereo pickup head. Produced in the U.S. by Dyna-Empire Inc., the cartridge is being distributed in Australia by Pantechna Pty. Ltd., of 6a Elizabeth Street, (4th Floor) Melbourne, C.I.

IN some respects, the new 108 cartridge resembles the type 88 unit reviewed in these columns, in the November issue, the general shape, mounting arrangements and terminal connections being similar.

However, the 108 is metal clad, special precautions having being taken to render it as insensitive as possible to external magnetic fields. This can be a very valuable feature, where hum induction is likely from the turntable motor or from nearby power transformers.

Like the model 88, the 108 cartridge uses the moving magnet principle but the distributors emphasise that it represents an even further—and somewhat more expensive—refinement of the basic design. The treble response extends somewhat further, the output and compliance is higher and, with a properly balanced arm, the tracking force can be as low as 1¼ grams.

A most interesting feature of the 108 (as for the 88) is that the method of construction allows a very low dynamic mass to be achieved in respect to the stylus tip; the manufacturers quote a figure of 0.7 milligram, which is much lower than in most other pickups. This very low dynamic mass allows the stylus to trace deeply modulated grooves with ease.

Pressure of other work prevented us from conducting detailed laboratory tests on the cartridge but independent tests we have seen confirm the manufacturer's claim to wide, level frequency response. Channel separation is adequate over the lower and middle register, though diminishing somewhat (as do many cartridges) in the extreme treble.

As distinct from laboratory testing, the cartridge impressed during quite lengthy listening periods, as did the model 88. Using a variety of stereo and mono discs, received for review, there was no sign of distress on heavily modulated passages, no groove skating, no noticeable response peaks or distortions of other kind.

Retail price of the Empire 108 cartridge, including tax, is £25/19/5. This compares with £20/12/7 for the model 88. (W.N.W.).

BRAMCO "UNIT" TRANSFORMERS

READERS contemplating construction of either the No. 1 or No. 2 Playmaster Unit Stereo Amplifiers will be interested in two pairs of output transformers released by Bramco Transformers.

One type, designated MF-2/2, is intended for use with the No. 1 Unit

BRAMCO
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tereo Amplifier, and has a 10,000 ohm ingle-ended primary winding and a hoice of 3.75, 8 and 15 ohm secondry taps.

The other, designated as type MF-7, is ntended for the No. 2 Stereo Unit, and rovides a 9,000 ohm centre tapped, primary winding, suitably tapped for ultra-linear operation. The secondary winding provides taps at 3.75, 8 and 15 ohms. Frequency response is quoted as 50 cps to 30 Kc.

Tested in the original units in our workshop, both types performed well up to the standard to be expected from transformers of this general class. In particular, no trouble was experienced in regard to phase rotation and instability, using the feedback networks shown in the published circuits.

Further details may be obtained from Watkin Wynne Pty. Ltd., 21 Falcon Street, Crow's Nest, N.S.W.

NEW INSTROL APPOINTMENT

INSTROL Ltd. advises that Mr Kenneth B. Morkham, who was with Repco Ltd., of Melbourne, for many years, has now joined the company as general manager.

Mr Morkham's wide experience in manufacturing production and management makes a major contribution to the company, particularly in relation to the subsidiaries, University Graham Instruments Pty. Ltd. and Air Compressors Pty. Ltd.

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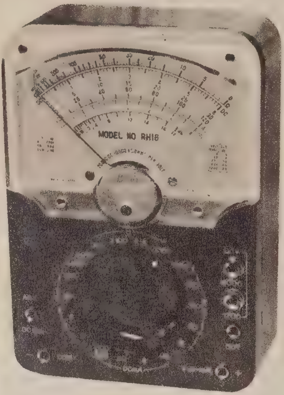

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* Up-to-date design
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* Rugged construction—clear plastic panel and moulded case
* Wide measuring ranges

SPECIFICATIONS

DC Voltages: 0-6-30-120-600-1200-6000V (20,000 Ohms/V)
AC Voltages: 0-6-30-120-600-1200V (10,000 Ohms/V)
DC Current: 0.60 uA, 0-6-60-600mA, 12A
Resistance: 0-5K-500K, 0-5Meg-50Meg (30 Ohms, 3K, 30K, 300K at centre scale)
Decibels: minus 20db to plus 63db in 5 ranges
Dimensions: (3 5-16" x 6 5-16" x 2¾")
Weight: (29oz approx.)
Batteries: Penlight 1.5V x1 and 15Vx1, testing leads with prods.

PRICE £13/15/-
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AC Voltages: 0-10-50-250-500-1000V (10,000 Ohms/V)
DC Current: 0-50uA, 0-5-50-500mA
Resistance: 0-10K, 0-100K, 0-1Meg, 0-10 Meg (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale)
Capacitance: 0.0001uF-0.005uF
0.005uF-0.1uF
Decibels: minus 20db to plus 36db in 2 ranges
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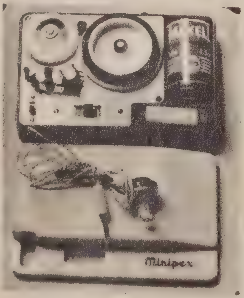

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AC Voltages: 0-5-25-100-500-1000V (10,000 Ohms/Volt)
DC Current: 0-50 uA, 0-5-50-500mA
Resistance: 0-6K-600K, 0-6Meg-60Meg (30 Ohms, 3K, 30K, 440K at centre scale)
Capacitance: 100uuF-0.01uF, 0.002uF-0.3uF
Inductance: 20 H to 2000 H
Decibels: minus 20db to plus 30db in 2 ranges
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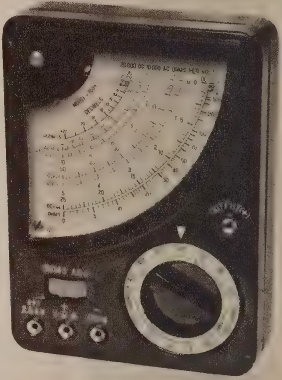

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20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

SPECIFICATIONS

DC Volt: 0-5, 0-25, 0-50, 0-250, 0-500, 0-2,500
AC Volt: 0-10, 0-50, 0-100, 0-500, 0-1,000
DC Current: 0-50, Micro-amperes
0-25, 0-250 Milliamperes
Resistance: 0-60K Ohms, 0-6Meg Ohms
Capacity: 0.01-0.3mfd (at AC 5 Volt)
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Decibel: minus 20db plus 22db
Output Range: 0-10, 0-50, 0-100, 0-500, 0-1,000
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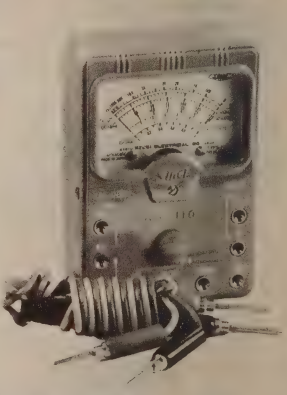

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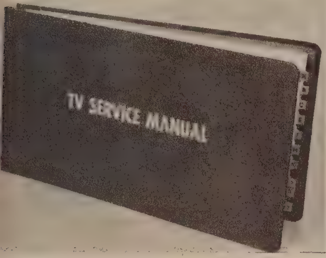
BOOK REVIEW

TV SERVICE MANUAL. Published by Westley Contractors, N.S.W. Hard cover loose leaf binder, 19½in x 10½in. Currently contains over 100 Australian TV circuits.

Ideally suited to any TV service organisation, this manual presents, for the first time, circuits of all the well-known Australian TV receivers in one binder. In most cases these are reprints of the manufacturer's original service sheets, ublished by special arrangement. The anual is indexed for easy reference.



Where circuits have been modified, oth the original and the new circuit re supplied, while provision has been ade for new sheets to be issued as hey come to hand.

A registration card supplied with the anual allows the purchaser to regis- er for the supply of these as they be- ome available. The charge will be 1/ er sheet, the number of sheets varying ith the particular issue.

This manual would appear to satisfy a ong standing need in the Australian TV ervice industry, and the price of 12/10/ would be quickly offset in time aved.

Our copy from the Australian distribu- ors, General Accessories Pty. Ltd., 100 larence St., Sydney, to whom all en- uiries should be directed. (P.G.W.).

* * *

CADMIUM SULPHIDE PHOTO-CONDUCTIVE CELLS. Published y the Miniwatt Division of Philips Elec- rical Industries. Twenty-four page booklet, 6½in x 4½in, consisting of graphs, echnical specifications, etc.

This booklet is being issued gratis by he above company, for the purpose of cquainting those interested with the haracteristics of this latest type of photo- ell. It contains some general comments n the characteristics and operating con- itions of these units, plus specific data, ncluding many graphs, of the five types f cell currently available.

Inquiries should be directed to "Mini- att," 20 Herbert St., Artarmon, N.S.W. .G.W.).

* * *

HOW TO USE GRID DIP OSCILLATORS, by Rufus D. Turner.

This book was reviewed in the May, 960, issue. Copies were not available n the local market at that time, our opy being direct from the publisher, ohn F. Rider, Inc., of New York.

We have since received a copy from IcGill's Authorised Newsagency, and e notification that the book is now vailable locally priced at 26/9, plus 1/ ostage.

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900' x 5"	44 0
1,200' x 5¾"	56 6
1,800' x 7"	77 3
DOUBLE PLAY—LGS 26	
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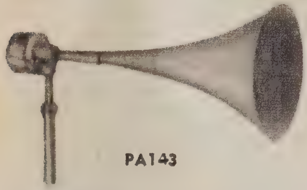

PA143

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Ivory timber cabinet with 7in speaker for applications where a bidirectional characteristic is desired.

PA73

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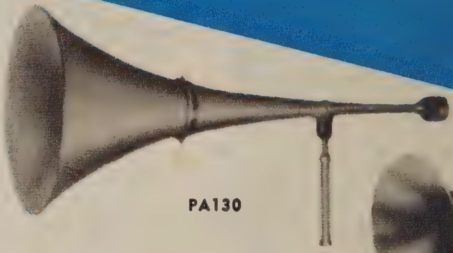
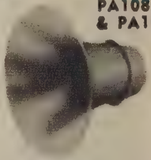


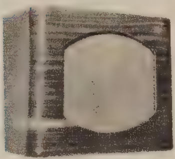
PA130



PA108 & PA10

Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.

These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency.



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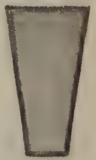
Attractive moulded cabinet with 7in cone speaker and 600 ohm line transformer. Suitable for wall or desk mounting. In grey, ivory and walnut.



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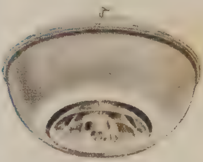

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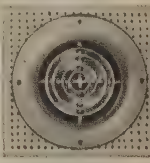

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OFF THE RECORD — NEWS & REVIEWS

REPORT ON STEREO HEADPHONES

As you will doubtless have gathered from an article elsewhere in the issue, the point of major interest during the past month has been the release, locally, of high fidelity stereo headphones. I think that this is going to be a matter of prime importance to audio enthusiasts.

By Neville Williams

I MUST admit that the idea of listening to headphones has not stirred me very much to date and even the picture of the Koss headphones was reproduced a few weeks ago only as a matter of casual interest. I guess that most of you still feel pretty much the same way.

However, as far as I am concerned, the interest is casual no longer and a pair of hi-fi stereo headphones is in the process of becoming a permanent feature of the domestic installation. If nothing else, I will be able to listen to a few tracks, in future, without worrying too much about what others in the household are doing.

As pointed out elsewhere, the majority of the headphones available to date have been rather dubious affairs in the acoustic sense, being little more than worked-over versions of telephone earpieces. One could never listen to them with any degree of relish.

Recently, however, there appears to have been quite a flush of hi-fi headphones released overseas. "Hi-Fi/Stereo Review" for example, lists the following seven as being currently available in the U.S.

Brush-Clevite, Melody Master, Koss, Telex Dyna-Twin, A.K.G., Magna and Telex Tele-Twin. The Koss were pictured in the November issue; the A.K.G.'s are featured elsewhere in the issue, this month.

Not all these phones were apparently intended initially for stereo listening, being simply adaptations of the moving coil or piezo-electric (ceramic) principle to provide improved headphone quality.

STEREO DID IT

If we had been limited to mono, I doubt that many would have got very excited about the hi-fi headphones. The sound through them is vastly improved, to be sure, but it lacks the diversity which the same sound tends to acquire when radiated from a loudspeaker into a normal semi-live listening room.

One thing that I did discover, very quickly, was the pronounced difference which phasing makes, when listening to mono sound and with a phasing switch readily available on one channel of the amplifier.

With the headphones in phase (i.e. both eardrums being pushed inwards simultaneously) the apparent source of sound is concentrated right in the centre of the skull between the two ears.

Flip the switch the other way and each ear seems to receive separate and rather unnatural signals which are the same only different — to borrow a schooltime phrase!

To date, I have had no special reason to observe phasing effects in earphones and had tacitly assumed, along with many others, that phasing didn't matter.

In the case of stereo, the effects are not nearly so obvious but, until someone shows me otherwise, I am going to assume that the most natural stereo effect will be obtained with the earphones operating in phase, as judged on an equivalent mono signal.

But stereo! What a fantastic effect it is, the first time one hears high-quality stereo on headphones. One is completely surrounded by sound and only slight pressure of the phones against the ears is there to remind one that the whole room is not, in fact, filled with it.

In a very real way, acoustically, one is translated into the native environment in which the recording was made. The inherent and traditional restrictions of headphones are replaced by an ability to present spatial effects more dramatic than from loudspeakers because, now, each ear hears one channel only—not a mixture of both channels.

This last statement conceals a multitude of potential arguments but, while these will all doubtless be conducted in due course, let the fact not be lost sight of that the reproduction, as heard, is extremely satisfying. It isn't a poor substitute for the real thing!

Having not heard them, I cannot speak for the other brands of phones mentioned, but the A.K.G. units tested certainly manage to fill in the spectrum from the most treble tinkles to the deepest bass.

Some may wonder how the tiny moving coils and diaphragms in headphones can develop good bass when there appears to be the greatest difficulty in doing so even with large loudspeaker cones and still larger baffle boxes.

CLOSED CIRCUIT

The answer is that headphones do not have to develop a large wavefront throughout the room, which can reach the ears of listeners sitting in quite random positions. They have only to activate the eardrums through the almost "closed circuit" involving the small amount of air enclosed in the space between headphone and eardrum.

Ideally, there should be an airtight seal between the two and some manufacturers recognise this by providing the headphones with large ear-muffs or by making the phones to plug directly into

☆

Even though the possibility has received frequent mention in overseas literature, during recent months, it is still quite intriguing to see and hear a pickup playing an LP stereo record with the turntable in just about any position you can manage to prop it. Here the trick is demonstrated with a "Playmaster" outfit, using the "All-Balance" pickup arm reviewed last month, and an Empire 108 stereo cartridge. We couldn't demonstrate it in a fully inverted position, because the record, turntable and motor would not have stayed together.

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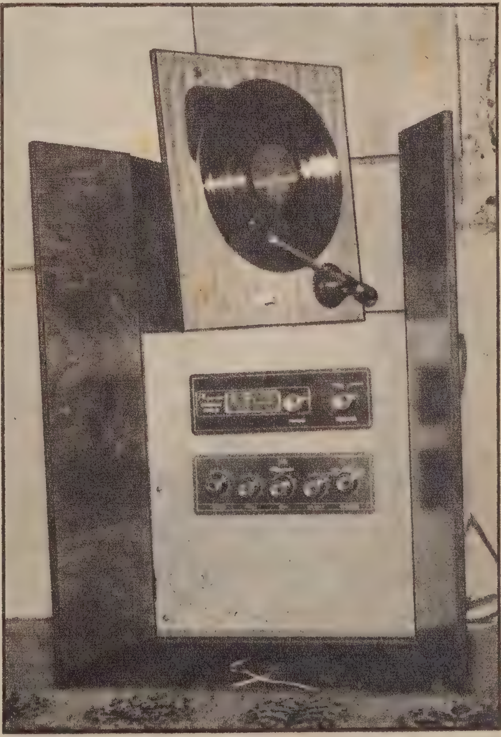

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Sapphire-diamond Styli £4/19/6.

GP67-2G.

High gain turnover crystal Cartridge, suitable for reproducing standard and microgroove recordings with low gain amplifier.

PRICE: Twin Sapphire Styli, £2/3/-. Sapphire/diamond Styli, £4/4/-.

GP61

Turnover ceramic Cartridge. Unaffected by heat or humidity. Specially designed for tropical areas.

PRICE:

Twin Sapphire Styli, £2/18/6. Sapphire/diamond Styli, £4/19/6.

HGP39

Crystal Cartridge. Available for standard or L.P. recordings for use with HGP20 and HGP40 Pick-up Arms.

PRICE:

Single Sapphire Stylus, £3/12/6. Single Diamond Stylus, £5/13/6.

ACOS STEREOPHONIC CARTRIDGES

GP73 Series

Turnover stereophonic Cartridge, plays all types of recordings. GP73-2 Medium output. GP73-5 High output. Available with standard ½" mounting bracket (type A), or special mounting bracket for end mounting (type B).

PRICE: Twin Sapphire styli, £3/6/-. Sapphire/diamond stylus, £7/13/6.

GP71 Series

Cartridge plays stereo and L.P. recordings, non-turnover type.

PRICES: GP71 with sapphire stylus, £3/6/-. GP71 with diamond Styli, £5/16/6.

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he ear canal, much as do stethoscopes nd hearing-aid earpieces.

Neither arrangement is particularly omfortable or hygienic and there is a ood deal to be said for the form in vhich the present A.K.G. phones have een released—flat plastic discs which imply rest against the external ear.

While, on test tones, a tighter seal loes produce extra level at 30 cps., musi-al reproduction is very full and very leasant with the phones merely resting omfortably in position.

The predominant sensation, when lis-ening to stereo headphones, is that one s surrounded by the sound. If called ipon to "localise" it—and this is a high-y subjective reaction—I would say that he sound appears to be spread along a ine to either side of the head, rather s if one were actually within the rchestra.

IFFERENCES

In this respect it differs from loud-peaker presentation where the sound ource is apparently spread out in front f the listener; this, simply by reason f the loudspeaker placement.

While I think that the "out-front" pre-entation is the more natural one, the in-line" disposition is by no means dis-greeable.

I have seen a few arguments, of late, overseas magazines, as to hether headphones are a legitimate ieans of listening to "stereo" sound.

The point is made that, because head-hones keep the two channels entirely eparate, they rightly belong to the "bin-ural" system in which the original re-ording should properly have been made ith microphones set in a dummy head.

Stereophonic presentation, on the other and, is based on the idea of recreating wall-of-sound in front of the listener, hich both ears can simultaneously hear nd analyse.

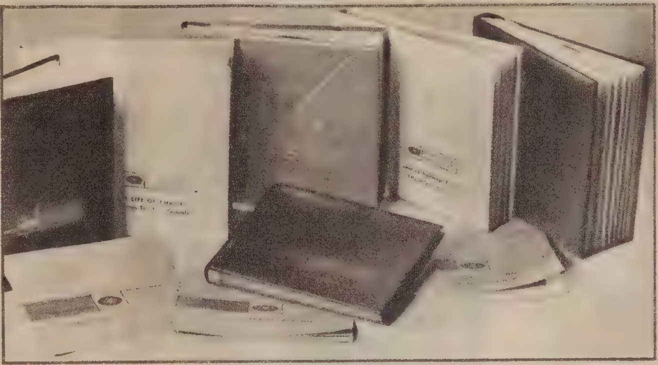
The two systems (so runs the argu-ent) are not compatible.

There is probably a good deal of truth this argument but also a large amount generalisation. Just as varying degrees "fakery" have resulted in good and ot-so-good stereo records, so I imagine ill the same records be found variously successful per medium of headphones.

It may well be that the technique of using a single stereo microphone is, after all, not too far removed from the binaural requisite.

But, as I said before, don't be put off by these and other arguments. They are all very interesting but the basic fact remains — stereo headphones can sound pretty impressive and they will bring far more pleasure than the stony silence to which hi-fi enthusiasts often find themselves condemned by circumstances.

NEW COMPLETE "AUDIO LIBRARY"



THE Gospel Film Ministry is now distributing what may well be the most elaborate "audio library" yet to be released in Australia. Comprising five albums and 34 discs — nearly all of them 12 inch L.P.'s — the library features selected readings from the Bible, readings from the Gospels detailing the life of Christ, a wide range of sacred music featuring 35 different artists and choirs, and a Children's album. The latter can be replaced by "A Treasury of Sacred Music," if desired. The records are fully "documented" in the brochures seen in the photograph. The promoters state that, while the material is based on Protestant practice, it is otherwise completely non-denominational. Cash price is £99/10/ but terms can be arranged. (Gospel Film Ministry Ltd., 599 George St, Sydney; also Melbourne and Brisbane).

A REVIEW OF SACRED RECORDS

"COUNT YOUR BLESSINGS," The White Sisters, accompanied and arranged by Harold De Cou. Mono, GFM (Gospel Film Ministry) 25-W 3053 LP.

The sound produced by the White sters will be familiar to anyone with a dio or TV set — three girls singing in ose harmony, with rhythmic accom-niment and employing a variety of refully rehearsed vocal tricks.

What is unusual is the application of e techniques to Gospel singing.

But, before saying "I wouldn't like at," you'd better hear these girls. Their rmony, the accompaniments and the rangements are as polished as anything 'e heard in the field of Gospel music.

Nor is it any surprise to learn from e cover notes that the White Sisters ve assisted at Billy Graham Crusades d are currently associated with Jack yrtzen in his "Word Of Life" pro-ams.

Selections on the disc are suitably varied, beginning with the well-known "Count Your Blessings," taking in a variety of more recent Gospel songs and ending with the traditional spiritual "Jubilee."

Technically, the recording is first-rate, in fact, the best I can remember on this label.

In short, I can thoroughly recommend the disc, both for its sound and as an object lesson for anyone with a personal interest in Gospel singing, group harmony and instrumental accompaniment.

* * *

"GEORGE BEVERLY SHEA" (Hymn collection), Mono, RCA Camden CAM-44.

George Beverly Shea, vocalist of the Billy Graham Evangelistic team, is not usually featured on the economy Camden label. The explanation, is this case, is probably that the selections included are not top favourites, while, technically, the recording lacks the ultimate precision and the sparkle to make it a really top quality disc.

For all that, Bev Shea enthusiasts will consider the purchase price well spent.

The titles: "If I Can Help Somebody"; "Now I Lay Me Down to Sleep"; "If I Could Pray Like a Child"; "Command and I'll Pray"; "The Holy City"; "Roll, Jordan, Roll"; "Goodbye Pharaoh"; "Stand By Me"; "Open Up Your Heart"; "The End of the Road."

* * *

"A FRIEND WE HAVE," Tennessee Ernie Ford and "The Jordonaires." Stereo, Capitol ST 1272.

The hymns on this disc will be generally unfamiliar to Australian listeners, being primarily part-songs and having their origin, apparently, in the southern States of the U.S.

As might be imagined, they are well presented by Tennessee Ernie Ford and the Jordonaires — a male quartet and well-established as recording artists. Instrumental accompaniment, arranged by Jack Fascinato, uses piano, celeste and organ alternatively, with bass and guitar.

The stereo is effective but unobtrusive, the soloist occupying a quite definite central position for most of the disc.

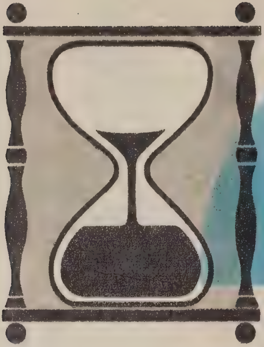
* * *

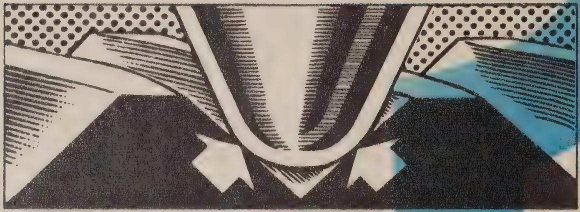
"YES, GOD IS REAL," sung by Frank Boggs. Mono GFM (Gospel Film Ministry) 43-W3046-LP.

Frank Boggs normally records for "Word Records" in the U.S. with full orchestra and, often, choir as well.

This disc is a truly solo effort in that Boggs plays his own accompaniments at the piano, as he apparently does, on

Are your playing hours wearing out?





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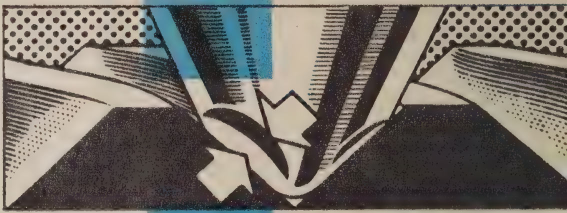

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many occasions, on the concert platform.

As a vocalist he sounds completely at ease, but his accompaniment is stilted by comparison, particularly in the first item from which the disc takes its name. Fortunately, his voice carries the day and the disc makes quite pleasant listening, after one has accepted its simple, personal formula.

The 13 numbers on the disc, many of them negro spirituals, are all well-known.

Technically, the disc is of excellent quality.

* * *

"IVORY PALACES," Lew Charles at the N.B.C. Pipe Organ. Mono, GFM (Gospel Film Ministry) 47-W 3054-LP.

This is a straightforward "Wurlitzer type" organ presentation of 12 popular gospel hymns of the Sankey-Alexander variety.

Lew Charles, who now appears to specialise in sacred music, appropriately avoids undue ostentation, while exploiting the organ enough to retain listener interest. Or should I say the interest of those who like Wurlitzer organs?

Be that as it may, this is another record which could be useful for background music prior to Gospel rallies, etc., with its smooth presentation and deliberately restricted dynamic range.

Technically, the general balance of the recording is good with low noise and low distortion.

* * *

"25 ALL-TIME SACRED FAVOURITES," Tedd Smith at piano, Hammond Organ and Celesta. Mono, RCA L 10936.

Tedd Smith was official pianist for the Billy Graham team, which recently visited Australia. Many will remember his complex — and popular — improvisations on hymn tunes, featured during the meetings.

Away from the platform and in the stony silence of R.C.A.'s Studio B, New York City, he seems to have lost something of his spontaneity. Or maybe it's the stony silence of a record and a living-room that makes the difference.

Whatever the explanation, the disc emerges as a fairly routine presentation of favourite hymns. However, I have no doubt that Crusade followers will enjoy it, by reason of its association.

Piano and organ are featured alternatively. Here and there the Celesta is heard and, at the most unexpected moments, the voice of Lois Winter.

Technically, the recording is good.

IN VARIED MOOD

"PAL JOEY"' (Rodgers and Hart), "NEW MOON" (Romberg). Produced by Cyril Ornadel. Mono, World Records Light Music Club, LM-70.

This is the disc with which World Records recently launched their Light Music Club. It was offered "free" to new members, on payment of their 10/ fee, and, as such, probably represents as good a record bargain as one could ever expect.

Numbers from "New Moon" include the overture, "Softly," "Stout-Hearted Men," "One Kiss," "Wanting You" and "Lover Come Back To Me."

From "Pal Joey": Overture, "Small Hotel," "Lady Is A Tramp," "I Didn't Know What Time It Was," "Bewitched," "I Could Write A Book."

My tip is that the "New Moon" selections will enjoy the most playings, being better known and, to my mind, having a slight advantage in presentation. Both sides are excellent, nevertheless.

Technically, the disc is good. The outer tracks are quite superb, in fact, but there is some loss of quality near the centre. Background noise is notable by its absence.

"ECHOES OF HOLLYWOOD, VOL. 5." (A Cavalcade of Hits from R.K.O.-Radio Pictures), played by Wilbur Kentwell on the Hammond organ, with Reg. Robinson, string bass. Mono, Columbia 330SX 7580.

Wilbur Kentwell plays the Hammond organ, theatre style, probably as well as any of the current overseas artists.

He teams here with Reg Robinson, who will be recognised, by Sydney residents at least, as the string bass player in the ATN Channel 7 television orchestra.

In this local recording, the two artists string together no less than fifty hit tunes, ranging from "I'll Always Be In Love With You" (1929) through the Walt Disney numbers of the late thirties to "Bundle of Joy" (1957).

It's traditional theatre-organ playing throuhgout with a lot of added boomp from the string bass, but the music is always catchy and tuneful.

Technically, the disc is of good average quality, though not quite up to the near-perfection of a couple of Kentwell organ-piano-duet discs reviewed some months ago.

* * *

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tempo to "show off" your stereo system this record will suit you fine. The piano plays the melody on the right, the percussion joins in from the left, and the vibes occupy centre stage.

Among the dozen "dancing and dreaming" tunes, all smoothly and pleasantly presented, are such numbers as "The Breeze And I," "The Way You Look Tonight," "It Had To Be You" and "Amor."

The quality of reproduction is completely clean throughout and the noise level nil.

* * *

"HIGHLAND PAGEANTRY," Pipes and Drums and Regimental Band of the Black Watch. Bandmaster W/O John Baker, L.R.A.M.; Pipe Major John McNicol; Drum Major Roy Dear. Stereo, RCA SL10350.

Had both sides of this 12in L.P. been occupied completely with the sound of bagpipes, I doubt that I would have enjoyed it as much as I did.

As it is, pipes, drums and brass band are there in force to ensure variety. For those who remain unmoved by the drums and the bagpipes, there's a full 10 minutes of rollicking brass band music on side two, contrived around the songs of Harry Lauder.

When all the instruments get going, there's a colossal amount of sound packed into the groove, but it's good, clean sound and the stereo helps enormously to spread it out.

"This is music to make the hackles rise" say the notes on the jacket. If you're Scot enough to know what a hackle is and your stereo system has speakers that will do justice to the drums, you won't lament the bawbees you spend on this disc.

* * *

"THE MAGIC TOUCH," Bill Snyder at the Piano with Orchestra. Stereo. Festival FST-11062T.

Bill Snyder's agile fingers fill the music with endless trills and runs but his touch is always caressing and "velvet smooth," as the cover notes put it.

Ah, yes, there were other instruments, come to think of it, supplying a trace of rhythm in the background. And it was stereo, too, though stereo doesn't count for a great deal on (almost) solo piano.

Mainly, this is the pleasant, unobtrusive, rippling kind of light piano music that goes fine as a background to eating, reading or dozing!

The quality? Good average.

* * *

"LAUGHS FOR LOSERS," Dave Barry. Recorded at the Hotel Sahara, Las Vegas, Nevada. Mono, London HAA 7626.

In unhurried fashion, Dave Barry examines the problems of mere man — women drivers, his family, TV westerns, his mortgages, his wife and so on.

Maybe I was in the right mood but I found myself laughing just as heartily as the audience through most of side 1. Side 2 was harder going but then what comedian can sustain the mood through two whole sides of an LP?

And what do you do with a humorous LP, anyway, after you've heard it a couple of times? Frankly, I'm not sure.

But, as funny men go, Dave Barry stacks up pretty well.

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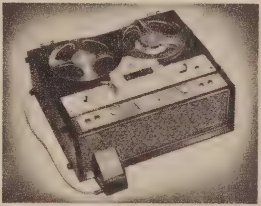

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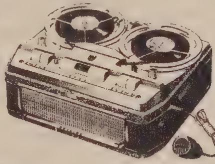

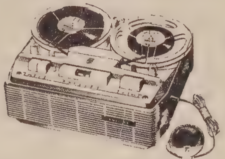

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IN REVIEW—By JULIAN RUSSELL

BRAHMS—"Close to Sentimentality"

Brahms — Symphony No. 1 in C Minor, Op. 68. Played by the Berlin Philharmonic Orchestra conducted by Karl Bohm. DGG Stereo 138113 SLPM.

Good Brahms, if without the propulsion of Klemperer's immensely solid reading. Instead, you will find lyricism that occasionally approaches dangerously close to sentimentality. A case in point is the little chain of effusive oboe solos in the first movement.

But these feminine touches are never more than transitory and generally speaking fit without incongruity into Bohm's flexible structure which is built on nicely contrasted moods throughout. A slightly more transparent recording would have helped thin out the composer's closely massed middle voices, but otherwise the sound is good.

* * *

Beethoven — Sonata in F Minor, Op. 57 (Appassionata). Sonata in D, Op. 10, No. 3. Played by Vladimir Horowitz. RCA Mono L16240.

This is disappointing Beethoven from a pianist of Horowitz's outstanding ability. His over-emphasis of the forceful contrasts in the first movement reduces the stature of this great music, and he follows it with a too-rigidly phrased slow section. But though his interpretation might fail to convince, his digital dexterity is faultless.

Horowitz carries the same mood of theatrical contrasts over into the D Major Sonata, though in the famous "largo e mesto" movement he rises to the occasion with some nobly delivered tragedy. And here again his tremendously agile technique enables him to play fast passages with a fleetness and delicacy that compel admiration. The European catalogues offer more desirable performances of both works.

* * *

Debussy — La Mer. Dances for Harp and String Orchestra. Roussel — Bacchus and Ariadne (Suite No. 2). Played by the Lamoureux Orchestra, Paris, conducted by Markevitch. DGG Stereo SLPM138073.

Some of the orchestral soloists seem to wander between the two speakers and the sound occasionally displays a tendency to coarseness in the Roussel. But the conductor insists as usual on playing of great precision and sensitivity in this charming French suite.

Except for the slight coarseness mentioned above, the sound is exceptionally clear and spacious, highlighting the fine string tone and splendid edge on the brass in the climactic passages.

You will not find the same occasional tonal coarseness in Debussy's La Mer, despite an extremely wide dynamic range. For all the delicacy of the playing, the bones of the work never become soft, and Markevitch's steady tempos allow him to impose much fine detail on to the firm skeletal structure. He scorns to splash around in an ecstasy of impressionistic ardor. Every effect is carefully considered and immaculately delivered. Yet nowhere is the work presented so precisely that the music loses continuity.

Suzanne Cotelle is altogether enchanting in the harp solos that Debussy originally composed in order to show off the technical capabilities of what was at the time a new type of instrument. Her phrasing is exquisitely shaped, her crystalline tone a continuing delight. She gets all the support necessary from Markevitch's orchestra without her dominant role ever being challenged.

* * *

Mahler — Symphony No. 4 in G Major. Played by the Chicago Symphony Orchestra, with Lisa della Casa. Conducted by Fritz Reiner. RCA mono L-16241.

Mahler enthusiasts might take exception to some of Reiner's "desecrations" of the composer's intentions, especially if they admire Kletzki's fine performance with the Philharmonia, which follows Mahler's markings with unquestioning obedience. But personally I don't find Reiner's deviations disturbing.

He adds weight to Kletzki's reading, but still preserves to a large extent the essential lucidity of this most popular of the composer's symphonies. And RCA's engineers have made a splendid job of the sound.

* * *

The Chicago Symphony under Reiner must now be numbered among the world's finest orchestras and even if they sometimes, in this work, fail to persuade you to accept without reserve the interpretation, they are never less than plausible and, to this listener, often moving.

Lisa della Casa sings the vocal line in the Finale with a freshness and accuracy that I found altogether beguiling.

* * *

The Conquest of Space — A Conversation between Dr Wernher von Braun and Willy Ley. Vox Science Series, Vol. 1. DL522. Mono.

Most readers of a technical magazine such as "R. T.V. and H.," will find little that is new in this conversation which seems designed to enable the participants to slap each other heartily on the back with true Teutonic solemnity. They discuss the first German rocket experiments, touch only lightly on von Braun's change of sides when the Allies seemed like winning the war, and go on to their more recent activities in America.

He mentions, by the way, that he was "permitted to bring with him 120 associates from Peenemunde to the U.S." There are a few interesting gossip sidelights on rocket production, and some very heavy-handed German humour. But this uninformed listener felt that a Russian team could add much illuminating information at present unknown to the two rather self-satisfied gentlemen who talk through clumsy tape joins for four 12-inch sides.

* * *

Schumann — Concerto for Piano and Orchestra in A Minor, Op. 54. Played by Van Cliburn and the Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Mono L16250. Stereo SL16250.

Schumann — Concerto for Piano and Orchestra in A Minor, Op. 54. Played by Dinu Lipatti and the Philharmonia Orchestra conducted by Herbert von Karajan.

Grieg — Concerto for Piano and Orchestra in A Minor, Op. 16. Played by Dinu Lipatti and the Philharmonia Orchestra conducted by Alceo Galliera. Columbia Mono 330CX7518.

Cliburn is at his best in the last movement, which calls for authoritative rhythm and has a fabric less susceptible to damage from Texan exuberance than the rest of the concerto. Elsewhere his formidably extroverted style, for all his obvious restraint, is too boisterous for this essentially charming and graceful music. It's all rather like the attractive young pianist himself — a little larger than life size.

Reiner presents a splendid compromise in accommodating the orchestral part to the soloist's needs whatever his own ideas on the subject might be. At any rate a photograph of him on the sleeve discussing the score with Cliburn hints at no great enthusiasm for what the young man is telling him.

The sound is fine on both pressings, but on two sides this is an extravagant way of acquiring the work.

The Lipatti performance, though way behind its competitor in terms of modern engineering, is incomparably superior in every other way. It has poetry, restrained ardour, and when necessary, plenty of spirit. And it has, too, a performance of the same considerable merit as the Grieg on the reverse.

It faces, however, overwhelming competition from the Solomon disc which couples the same two concertos, and the Richter which has a bracket of superbly played piano solos by Schumann on the reverse.

* * *

Beethoven — Symphony No. 1 in C Major, Op. 21. Symphony No. 2 in D Major, Op. 36. Played by the Columbia Symphony Orchestra conducted by Bruno Walter. Coronet Stereo KLCS2699.

Beethoven — Symphony No. 6 in F Major (Pastoral) Op. 68. Played by the same. Coronet Stereo KLCS673.

Beethoven — Symphony No. 7 in A Major, Op. 92. Played by the same. Coronet Stereo KLCS2700. All issued on mono, too, but no pressings were submitted for review.

* * *

Beethoven — Symphony No. 6 in F Major (Pastoral). Played by the Orchestra of the Suisse Romande conducted by Ernest Ansermet. Overture — Prometheus. Played by the same. Decca Stereo SXLA2193.

Beethoven — Symphony No. 6 in F Major (Pastoral). Played by the Vienna Philharmonia Orchestra conducted by Pierre Monteux. RCA Mono L16249.

Beethoven — Symphony No. 3 in E Flat Major (Eroica). Played by the Sudwestfunk Orchestra of Baden-Baden conducted by Joscha Horenstein. Vox Mono ALP10700.

Beethoven — Symphony No. 9 in D Minor, Op. 125. Played by the Orchestra of the Society of Concerts of the Paris Conservatoire with the Elisabeth Brasseur Chorale and Wilma Lipp (soprano), Marga Hoffgen (contralto), Marray Dickie (tenor), and Gottlob Frick (bass), conducted by Carl Schuricht.

Beethoven — Fifteen Variations and Fugue in E Flat Major for Piano (Eroica Variations) played by Shura Cherkassky. World Record Club Mono TE 227/8.

I have bracketed all these together to economise on space. To summarise, in terms of perfection, the only close competitor to the Walter series is Klemperer's and your reasons for preferring one to the other will be purely personal. My own choice goes to Walter whose humanity appeals to me more than Klemperer's massive nobility. One symphony, however, strikes me as towering far above my challenger's — Walter Pastoral.

Here is all the warm lyricism of his old 78s recorded back in the 1930s, for many years my favourite performances, repeated and enhanced by modern sound engineering. Every phrase is shaped with lapidary perfection, every bar balanced with an incomparable sense of classic proportions. And the playing everywhere glows with a warmth that comes from love and understanding controlled by an intensely musical intelligence. I have no hesitation in recommending it above all others, though those who admire the truly German school may disagree with me when they hear Klemperer's.

Ansermet's Pastoral is thoroughly enjoyable if not very enterprising. There are a few departures from strict orthodoxy some of which seem contrived rather than felt. An unusual fault to meet in this fine orchestra is some off-the-target intonation in the woodwind and occasional untidiness in the string ensemble. All the same, the disc is eminently pleasing and the sound fine.

FRENCH ORIGIN

Not surprisingly, when Monteux' French origin is remembered, his Pastoral is much lighter, or perhaps daintier, than Walter's. But it has about it a consistent sprightliness that may win it many admirers. While I do not place it within reach of Walter's superb achievement, it belongs, in my opinion, in the very next rank. The sound is excellent.

Horenstein, too, comes close to top rank in his splendidly spacious account of the Eroica. His interpretation is uncompromisingly classical yet never pedantic. His undeviating tempos never degenerate into mechanical time-keeping. Their pulse has life as well as regularity. Unfortunately the sound engineer has not served him well by modern standards.

I enjoyed most the Scherzo and Finale of Schuricht's Ninth. The other two movements have an air of dragging interminably. But the disc has the merit of offering splendid choral singing and the vocal soloists deliver their almost unsingable parts with fine spirit and accuracy. The tendency nowadays, however, is to put the whole of the Ninth Symphony on to one 12 inch disc, or at any rate, on to three sides of two 12 inch with a smaller work as a bonus on the fourth side. Here Cherkassky plays the Eroica Variations with commendable efficiency if without much profundity.

★ ★ ★

Berlioz — Symphony Fantastique, Op. 14. Played by the Philharmonia Orchestra conducted by Andre Cluytens. Columbia Mono 33CX-1673.

Berlioz — Symphony Fantastique, Op. 14. Played by the Bamberg Symphony Orchestra conducted by Jonel Perlea. Vox Mono ALP-11090.

Of these two performances the Columbia is much the better. It can, indeed, be compared to the two best available, Beecham's and Markevitch's, and Markevitch's sound has not all the benefits of modern techniques. I still prefer Beecham's tremendously imaginative reading, though I must admit that Cluytens wins an incomparable performance from the Philharmonia, a performance which, for all the skill of the players and conductor, Beecham's French orchestra cannot match.

I think, too, that Columbia's sound has slightly more presence than Beecham's. But despite all these advantages, Cluytens' performance, fine though it is, just lacks Beecham's panache. On the credit side there is Cluytens' beautifully spaced Scene in the Fields, his magnificently aggressive March to the Scaffold, and the impure fantasy of his Witches' Sabbath.

If you have neither, listen to both before you buy, but if you already have the Beecham, don't bother about the new one. The Vox makes a very poor show in such company.

★ ★ ★

Verdi—Aida. Complete Opera. Renata Tebaldi (Aida); Giulietta Simionato (Amneris); Carlo Bergonzi (Radames); Cornell Macneil (Amonasro); Arnold Van Mill (Ramphis); Fernanda Coreno (The King). The Vienna Philharmonic Orchestra and the Singverein der Gesellschaft der Musik-freunde conducted by Herbert von Karajan. Decca Stereo LXT5539/40/41.

Those who have stereo equipment will be pleased that they waited for this set despite the grandeur of the mono issued earlier. They will find all the expected "improvements." It has gained quite wonderfully in perspective, notably in such spots as the Priestesses' Song in the Temple Scene, the faintly heard chorus at the beginning of the Nile Scene, and the massive deployment of the vast resources at the end of Act 2.

The sound opens up a rich frieze along the wall, and give and take a bar here and there where one of the soloists doesn't quite measure up to an opposite number in other sets, together with the slightest possible surface roughness in pianissimo passages, this is as fine an Aida as anyone could desire.

★ ★ ★

Rachmaninoff—Symphony No. 2 in E Minor, Op. 27. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet Stereo KLCS2726.

(Continued on page 97)

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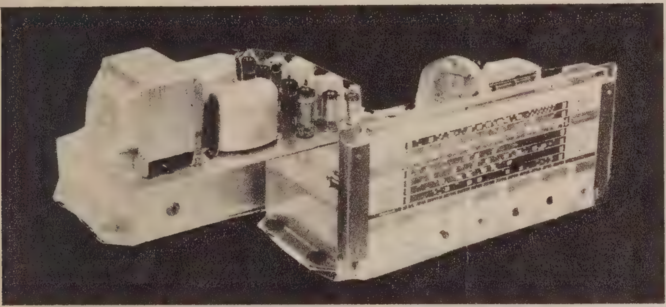

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Ormandy keeps a tight grip on the architecture of this ultra-romantic symphony, at the same time winning from his orchestra the utmost in voluptuous sound. Here is the Philadelphia at its most sumptuous, its virtuoso soloists beautifully balanced against a string ensemble of unlimited richness and vitality—except in one spot in the Adagio where the solo clarinet is slightly too forward.

There is another place, too, in the first movement, where a solo violin acquires a little more presence than he would in a concert hall. But these bars excepted, the disc should thrill all those who enjoy Rachmaninoff's expressive nineteenth-century romanticism. The engineering is superb.

* * *

Mozart—piano Music for Four Hands. Sonata No. 4 in F Major (K.497), Sonata No. 5 in C Major (K.521), Andante and Variations in G Major (K.501). Played by Ingrid Haebler and Ludwig Hoffmann. Vox Mono DL432/2/

Formally mellifluous playing is here fuzzed a little by over-resonant recording that puts a halo round many of the notes. The piano tone is of ultra-faithful type heard only away from the gramophone if the listener places his ear to the instrument. Happily, however, the mechanical noises of dampers and hammers falling that usually intrude in this technique are absent here.

The performances are well-intentioned and methodical rather than exciting, and monotony is not always successfully avoided. An inspirational spark is missing in this collaboration that is as punctiliously correct as an eighteenth-century diplomatic council.

* * *

Chopin—Etudes, Op. 10 and Op. 25 (Complete). Preludes, Op. 28 (Complete). Waltzes (Complete). Sonata No. 2 in B Flat Minor, Op. 35. Played by Guiomar Novaes. Vox Box, Mono. VBX401/

Miss Novaes' playing is uneven on these three discs which are put out economically at 97/6 in what the manufacturers call a Vox Box. Miss Novaes is a little capricious—and plucky—in the matter of tempos, starting some of the pieces at a speed she seems unlikely to be able to sustain successfully, though she always manages to do so.

She has a fluent technique and no little grace, and though most of the pieces offered here are now available played by other pianists in more up-to-date tonal guise, the price at which they are issued here should make them an attractive buy.

* * *

Mozart—String Quartets in G Major (K.80), D Major (K.155), G Major (K.156), C Major (K.157), F. Major (K.158), B Flat Major (K.-159), E Flat Major (K.160), F Major (K.168), A Major (K.169), C. Major (K.170), and Adagio and Fugue in C Minor (K.546). Played by the Barchet Quartet. Vox Box Mono. VBX12.

* * *

With the exception of the great C Minor Adagio and Fugue these are all very early works, many of them no more than formative in style. But since they were written by Mozart, even these works, unimpressive though they might be when his later quartets are remembered, have some entrancing moments.

Students will be interested to note the extent of the predominating Italian influences and the hints of better things to come with the composer's maturity. The playing throughout is stylish, the ensemble admirably co-ordinated, and the string tone excellent. The sound is first rate, and at 39/2 a disc, with the box thrown in, they represent very good value.

* * *

Haydn — Symphony No. 94 in G Major (Surprise). Symphony No. 101 in D Major (Clock). Played by the Vienna Philharmonic Orchestra conducted by Pierre Monteux. RCA Mono L16254.

Here are two popular Haydn symphonies played with rare refinement and sophistication. Monteux avoids forthright simplicity by imposition of subtlety of accent and phrasing. Moreover, his orchestra plays throughout with a delicacy that can be changed to a sparkle whenever he calls for increased brilliance.

The sound engineer has avoided the prevailing tendency to record with too much resonance and has placed his woodwinds in perfect balance with the rest of their colleagues. The Vienna Philharmonic's matchless string tone is here heard at its best, too. Enthusiastically recommended despite an occasional fleetness of tempo that may raise purist eyebrows.

RECOMMENDED

Mahler — Lieder Eines Fahrenden Gesellen. Kindertotenlieder. Sung by Christa Ludwig with the Philharmonia Orchestra conducted by Sir Adrian Boult — Andre Vandernoot. Record Society, 11/6011.

A Concert Gala. Mozart — Overture to Figaro. **Debussy** — La Plus que Lente. **Bizet** — Aragonaise from Carmen. **Tchaikowsky** — Waltz from Serenade for Strings. **Strauss** — Gypsy Baron Waltzes. **Wagner** — Introduction to Act 3, Lohengrin. **Elgar** — Pomp and Circumstance March No. 1. **Khatchaturian** — Sabre Dance. Played by the Capitol Svmphony Orchestra conducted by Carmen Dragon.

Music of Franz Liszt. Mazeppa. Les Preludes. Hungarian Rhapsody No. 2. Rakoczy March. Played by the Boston Pops Orchestra conducted by Arthur Fiedler.

Bernstein — Dance Music from West Side Story. Robert Russell Bennett — Symphonic Picture of Gershwin's Porgy and Bess. Played by Bennett conducting the RCA Symphony Orchestra. RCA Mono L16256.

Schumann — Carnaval. Chopin — Les Sylphides. Played by Robert Irving and the Philharmonia Orchestra. HMV Stereo OCSD1271. **Sabre Dance.** Suites from Gayaneh (Khatchaturian), Masquerade (Khatchaturian), and The Comedians (Kabalevsky). Played by the Hollywood Bowl Symphony Orchestra conducted by Alfred Newman.

Grofe — Grand Canyon Suite. Beethoven — Wellington's Victory otherwise known as the Battle Symphony (good fun, this) played by Morton Gould and his Orchestra. RCA Mono L16252. Stereo SL16252.

Alexander Kipnis in Russian Opera. Songs from Moussorgky's Boris Godounov, Tchaikovsky's Eugen Onegin, Rimsky-Korsakov's Sadko, Borodin's Prince Igor, and Dargomijsky's Rousalka. With the RCA Victor Symphony Orchestra conducted by Nicolai Berezowsky. RCA Camden 39.

Prokofieff — Peter and the Wolf. Saint-Saens — Carnival of the Animals. Played by Efrem Kurtz and the Philharmonia Orchestra. Michael Flanders (narrator). Abbey Simon and Hephzibah Menuhin (two pianos). HMV Stereo ASD299.

A Recital of Bach and Handel Arias by Kathleen Ferrier with the London Philharmonic Orchestra conducted by Sir Adrian Boult. Decca Stereo SXLA-2234. (A quite wonderful "fake" of a stereo orchestra dubbed on to an original mono).

Gilbert and Sullivan — H.M.S. Pinafore, complete with dialogue. The D'Oyly Carte Opera Company and the New Symphony Orchestra of London conducted by Isador Godfrey. Decca Mono LXA 4334/5.

Gilbert and Sullivan — Iolanthe. George Baker, Elsie Morison, John Cameron, Monica Sinclair and others, with the Glyndebourne Festival Chorus and Pro Arte Orchestra conducted by Sir Malcolm Sargent. HMV Stereo OASD-323/4.

Mahler — Symphony No. 1 in D Major (The Titan). Played by the Pittsburgh Orchestra, conducted by William Steinberg. Record Society Mono 5/6005.

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AMATEUR BANDS WITH BILL MOORE

W.I.A. PLAN TO ASSIST CLUBS

In all parts of Australia concerted action is being taken to interest teenagers in Amateur Radio. Much of this work is being performed by individual amateurs but clubs in various locations and in schools are playing an important part in educating the youngsters in aspects of the hobby.

THE formation of a committee by the N.S.W. Division of W.I.A. to report on the possibility of developing a scheme for the co-ordination and sponsorship of radio clubs for young people of school age, youth clubs, etc., could have an important bearing on the future development of the amateur service.

The Division's Educational Officer, Harold Burtoft, VK2AAH, Rex Black, VK2YA, and Ken Mattei, VK2KM, will meet shortly to investigate suitable action to implement the proposed scheme.

TEACHERS ACTIVE

At the moment a number of amateurs, members of the teaching profession, are actively engaged in running radio clubs for pupils at their respective High Schools.

Rex Black, VK2YA, of the Vaucluse Boys' High School staff has originated a system of proficiency certificates to give members of the school club a definite incentive and direction in their activity.

The club is called VK2AVV.

One of the best known school clubs is that of the Christian Brothers Intermediate Technical High School at Newtown and the club station VK2ATQ is heard operating consistently on 7 and 14 mcs.

The club was sponsored by Brother Lee Kinsella, VK2AXK, who has performed a splendid service in this regard.

Another strong school club is at Coff's Harbour High, where Ken Mattei, VK2KM, has introduced pupils to amateur radio via his own station.

Keith Howard, VK2AKX, of Booragul High School, has also organised a radio club and they soon will establish their own school amateur station.

Two other schools at which clubs have been formed are Bass Hill High School where Mr Hodgkins and Mr Hanson, of A.W.A., are in charge; and at Cranbrook School where the Science Master, Mr Bishop, is organising the club.

It is hoped the W.I.A.'s scheme will ensure that all High School pupils are rendered every opportunity to learn the radio art as such action could lead to many of them eventually joining the amateur ranks.

There is certainly much work to be done in this sphere and amateurs who assist must be congratulated on their initiative. Every amateur should encourage and assist young people to take up amateur radio.

It is not only the matter of the value to the hobby, but any knowledge gained by youngsters can be of considerable use to them in any technical vocation they desire to follow.

HAMS' FINE EMERGENCY RECORD

The story of the work of radio amateurs in two national calamities, showed clearly the value of the movement in the public service. The first operation was during the crisis in the Congo and the rapid evacuation of Europeans from that country. Communication was provided between Belgium and the Congo by radio amateurs using mainly the 21 mc/s band. Hundreds of messages were handled daily, assisting the repatriation and providing information on the welfare of persons remaining in the Congo.

The net was also used to assist Europeans in isolated areas in that country, and much of the operating had to be performed under cover. The work still continues on a reduced scale and the whole action has been described as the most extensive operation yet carried out in the public interest by radio amateurs.

The second disaster was the Chilean earthquake and for two months radio amateurs provided in most cases the only means of communication with devastated areas.

The net was set up between 7,000 and 7,100 kc/s and over 50 CE amateurs worked almost continuously to produce communication that was to assist the rescue of many, and alleviation of the suffering of thousands. Graphic stories have been told of the work of individual amateurs and the result of the whole operation must have a tremendous impact on the public evaluation of the amateur service.

In early December Harold Whyte, VK2AHA, performed an emergency service on his own. Hearing a May Day call from a missing launch out from the coast going unanswered, he immediately contacted the authorities and his action was responsible for the final locating of the missing craft. Full details of the rescue are at this time unavailable, but it was another mark on the credit side for the radio amateur.

N.S.W. Div. Field Day

The Australia Day weekend in January is the date for the premier amateur radio event in N.S.W., the Division's Annual Field Day and Convention. The main session will be held in the 5 acre grounds of VK2WI at Dural.

The convention actually commences with the January general meeting, to be held at Science House, Sydney, on January 27, when a special lecture will be presented. Dural will be the centre for the Saturday gathering. Some 400 persons assembled there for last year's convention.

Emphasis this year will be on practical demonstrations featuring SSB, VHF activities and other techniques. There will be the usual disposals sale, and a blindfold 144 mc/s hunt, to provide a little exercise. Everyone attending will have time, too, to talk to their friends and visiting country amateurs.

The Sunday, January 29, program will provide 144 mc/s fox hunts, mobile rallies and the like. Monday, Australia Day, is clear for amateurs to recuperate and for country visitors to return home.

The whole program provides plenty of interesting features for amateurs and their families and the weekend should be marked down for attendance at one or all of the scheduled events.

Full program details will be provided via the bulletin and the VK2WI Sunday broadcast.

Gosford Field Day

In excellent weather a large crowd assembled for the 4th annual Field Day of the Gosford Radio Club, central coast section of the W.I.A., held at the Gosford Sailing Club. With over 100 registrations, the total gathering neared 250 persons. Many were the attractions for all attending with a launch trip for the ladies, plus plenty of field events and disposals for the OMs.

The usual smooth arrangements were a feature of the event with members and their wives working hard to ensure all visitors were well catered for.

A display of the latest in American amateur receivers and SSB transmitters was a centre of attraction and some of the gang were digging deep to see if they could afford such fine equipment.

The entry in the field events was the heaviest recorded, and this was evident from the field of mobile whips and beams surrounding the club house.

The morning 144 Mc/s field event was won by DF specialist Dave Andrews, VK2AWZ, while Bill Hall, VK2XT, won the prize for travelling the shortest distance to find the hidden transmitter.

The 144 mc/s afternoon hunt, after a start when all the hounds were driving around without hearing a signal, was restarted and Bob Lear, VK2AZ, was first in with Dick Norman, VK2ZCF in second place.

The 7 Mc/s scramble was keenly contested and Bill Hall, VK2XT, with a tally of 20 contacts, just beat Dave Andrews, VK2AWZ, 19 contacts, for first placing.

Ian McCosker, VK2AXI, from Moree, travelled the greatest distance to win a special prize. Tom Kenn, associate, proved too good for all the amateurs in the quiz contest, to win this competition, while Mrs VK2BZ was a clear winner in the ladies' quiz.

The daughter of Perce Healy, VK-2APQ, won the mantel radio. Pat was lucky and unlucky as she returned home to bed and German measles—the radio provided entertainment, however.

All who attended proclaimed it the best field day yet conducted by the Gosford Radio Club.

N.S.W. Division W.I.A.

The lecturer at the November general meeting of the N.S.W. division was Harold Burtoft, VK2AAH, who provided an interesting and instructional discourse on antennas.

Harold spent two hours covering antenna theory and operation, and spoke on the cubical quad, the bird cage, the folded dipole and mobile whips in particular. Audience participation was high, plenty of questions posed, a clear indication of the interest shown in this popular subject.

The November mid-month meeting of the division held at the administration H.Q., Crow's Nest, was devoted to a film evening. The showing covered "Decca," an aircraft D/F system used extensively on the Continent, the conquest of the atom, transistors and the ionosphere.

A new appointment in the N.S.W. division is Bill Storer, VK2EG, (well known operator from the Antarctic) who takes charge of the register of members. Bill will ensure you obtain your Bulletin and Amateur Radio on time. To make this possible, any changes of address should be immediately recorded with the divisional secretary.

Plans for the extension of the N.S.W. division's Administration Headquarters at Crow's Nest have been approved in principle by the local Municipal Council. The State president, Bill Lewis, VK2YB, building officer, Phil James, VK2ER, and the architect, have been in conference on a number of occasions. Final plans are being prepared for a two-storey structure behind the present premises. The ground floor opens to the lane at the rear of the block and will provide space for the disposals committee as a store.

OFFICE PREMISES

The top floor will be used as a hall and amenities section. The project also covers the conversion of the front section of the present building into office premises by 1965. Membership of the division is still growing and these changes will ensure further development and services for members.

Lecturer at the Blue Mountains section meeting was Max Pleffer, VK2MP, who journeyed to the Mountains with Tim Mills, VK2ZTM, N.S.W. councillor. Max talked on SSB, its history and transmission and reception. The lecturer set out to explain the system in simple terms in an endeavour to interest and not confuse the users of the ancient system.

A list of N.S.W. amateur stations of considerable value to amateurs who travel around country areas is now available free of charge from the N.S.W. division of the W.I.A. It was prepared by Syd Molen, VK2SG, and lists stations in order of towns in N.S.W. Any person contemplating a country trip should obtain the list.

50 Mc DX Report

The 50Mc/s Band in November provided some very interesting openings for Victorian Amateurs. Early in the month the VK4's appeared on a number of occasions while signals from VK2, VK5 and VK3 country stations were heard for brief periods.

On November 13, for the second time in V.H.F. history in that State, an auroral opening occurred. It commenced at 1630 hrs EAST, and a number of country stations were contacted by Melbourne stations beaming south into the aurora. All signals had a strong rumble on them making copy difficult at times.

VK3ZJE made a brief contact with VK2WH during one period. A JA was also heard during the evening.

On November 14, Sporadic E provided excellent VK2, 4 and 5 signals for nearly two hours. Similar openings occurred on a number of evenings while on November 18, excellent JA signals up to S9 at times, appeared from 1330 to 1415 hrs. EAST. November 1960 provided the best openings for many years during that month. Mac Hilliard provided the above information.

Scatter Propagation

The IARU Region 1 VHF Committee has accepted in principle a standard method of signal reporting on Meteor Scatter Propagation Signals. The signals on the 144 Mc/s band are received in bursts of varying duration and strength. Those of shortest duration are known as pings and may only last for a fraction of one second, providing only a portion of a dot or dash. The longest could be heard for up to several minutes and are produced from trails of large meteors.

The normal QSO, as we know it, could not be carried on as signals only appear for such short periods, so an abbreviated form of contact has been introduced. The ARRL suggests that the minimum requirement for a QSO to be complete are the exchange of: (a) Both call signs; (b) The report; (c) The final R.

The RST form of signal reporting is not really applicable so the following system using two digits has been adopted. The Duration code runs as follows, S1—Pings, S2—Bursts up to five seconds, S3—Bursts from 5 to 15 seconds, S4—Bursts from 15 seconds to 2 minutes and S5—Bursts of more than two minutes' duration. To the above is added the normal 1 to 9 strength figure, thus a S26 report would indicate bursts of up to five seconds are being received at strength 6.

A number of two letter abbreviations have also been introduced to further shorten operation procedure. For instance, YS means I need your call sign and report and YC I need your call sign only.

Contacts via meteor scatter are attracting many VHF amateurs overseas. Stations separated by between 500 and

PRICES RADIO

5 and 6 Angel Place,
SYDNEY.
Phone BL3146

JANUARY IS OUR CLEARANCE MONTH!

BARGAINS GALORE!

Too numerous to list here so call or send a stamped addressed envelope for complete list.

STOP PRESS

Just arrived
New shipment of
TECH. MULTI-METERS

Ranges 10 to 1000 A.C. or D.C. 1 to 500ma D.C. 1 to 100k ohms.

VALUE PRICED 61/6
Plus 3/- post

FERRIS

HIGH-GRADE COMPONENTS BY MAIL

FERRIS BROS. ask you to compare these prices for first grade components, remembering that you have nothing extra to pay; goods are delivered free, tax is included.

TRANSFORMERS AND COILS FOR TV RECEIVERS:

Power Transformers for TV Amplifiers, etc. Few left. Unbeatable value. 220-240V in 285-0-285V. 300mA and 6.3-0-6.3V 5 Amps out, 3¾in x 3in centres 4 hole mounting: fitted with electrostatic and electromagnetic shields.

Type TVP128. Delivered, only	£3 5 0
Filter Chokes, 10 Henry, 3 1-8in centres, 2 hole mounting, for use with TVP128 transformer. Cap input filter. Type TVP127. Full price	15 0
Filter Choke for TV and amplifiers, 300mA 1H. Type 817	16 2
1st Video I.F. with 30.5 Mc/s trap, no can type 943	11 4
2nd and 3rd Video I.F., no can type 941	10 9
Video Detector Coil, 7-8in sq. can type 945	13 1
Sound take off transformer 5.5 Mc/s T206 in 7-8in square can	11 9
Ratio Detector; T102; 1 3-8in sq. can	16 4
Video series choke, L204, 36 uH, to improve picture quality	3 0
Video plate choke L205, 250 uH	2 10
Peaking Coil 300 micro H. L208	3 0
Peaking Coil 400 micro H. L903	3 0
Spook Suppressor for damper tube L403, 1.5 uH; on resistor blank	3 9
Horizontal oscillator coils for 6BL8, type 780	5 0
Deflection Yokes. 70 degrees; 17 inch; Universal type	£2 5 0
Safety Glass Screens, flat tinted, 21 inch	£2 5 0

COMPONENTS:

Miniature Potentiometers, 3 Meg Ohm ¾in Spindle, Bush Mounting	4 0
Miniature Potentiometers, 3,000 Ohm ¾in Spindle, Tab Mounting	3 6
Miniature Potentiometers, 3 Meg Ohm ¾in Spindle, Tab Mounting	3 6
Miniature Potentiometers, 500,000 Ohm ¾in Spindle Tab Mounting	3 6
Miniature Potentiometers 500,000 Ohm, 15/16in Spindle, Bush Mounting	3 6
Potentiometers Dual Concentric 1,000 Ohm over 500,000 Ohm with outer spindle 1in and inner spindle 1½in fitted with 250V 10A D.P.S.T. switch	17 3
Potentiometers D.P.S.T. 500,000 Ohm with 1¾in spindle	7 0
Potentiometers 1 meg. ohm, with 1½in spindle	3 6
Potentiometers 100,000 ohm plain M93	3 6
Potentiometers 1 meg. ohm D.P.S.T. with Tongue Spindle M93 and M92	7 0
Condensers Variable 3 Gang with ¾in Spindle	23 0
Condensers Variable 2 Gang with 5-8in Spindle	15 11
Condensers Electrolytic 500 mfd 12V P Type ET5D	4 0
Switches Oak S/S 3 pole, 3 position. Various Spindle lengths from ¼in to 1½in	7 0
Knobs, Tuning, etc. Brass Chromed, suit ¼in shafts	1 8
Knobs, Type MV6—Grey	1 2
Housing Speaker 6in under Shelf or Rear Shelf for car radio, etc	14 8

COMPONENTS (continued).

Connectors fuse flanged complete M.F.	1 9
Connectors—microphone cable M and F. complete	15 1
Connectors Amphenol	1 6
Sockets—valve or vibrator 6 pin with circlip	1 8
Cloth—suit radio speaker grilles, colour blue	12 9
Dials—Hub moulded on brass boss, 2¾in diameter x 3-8in bore	3 5
Dials—Hub cast gunmetal 2in diameter x 3-8in bore	2 2
Plugs—4 pin miniature	0 11
Valves—6H6	2 0

BROADCAST BAND COILS:

Aerial coil, 1 3-8in round can. Special High Q	8 0
Aerial Coil, ¾in square can, bakelite paper former	6 7
R.F. Coil, 1 3-8in round can. Special High Q	8 5
R.F. Coil, ¾in square miniature can. Polystyrene former	7 0
R.F. Coil. ¾in square miniature can. Bakelite paper former	6 7
Oscillator coil in 1 3-8in round can	6 10
Miniature oscillator coils in ¾in sq. can for 6AN7, 6A8 or 1R5 Valves	4 8
Miniature oscillator coils in ¾in sq. can for 6BE6 valve	3 3
I.F. transformer for 455 kc/s in 1 3-8in round can. Special High Q	9 9
I.F. transformer for 455 kc/s in ¾in square can, Universal, type 119	9 1

CABINETS SUITABLE FOR TV OR SPEAKER UNITS. Few left.

Beautifully polished Walnut veneer 17in Console	£6 10 0
21in Console	£11 0 0
21in Consolette	£6 10 0

POWER SUPPLIES:

Fully encased, 240V input 300V 150mA fully filtered D.C. out, three filament windings 6.3 and 5V. Complete with 5V4G rectifier	£8 15 0
Push-Pull output Transformer, well-known make. Flat response 60 c.p.s.—10 kc, Impedance primary 10,000 ohm. Secondary 16 or 8 ohm	£4 16 2

AND MANY OTHER TV AND RADIO COILS AVALABLE FROM STOCK

SPECIAL OFFER:

Manually operated permeability tuners for car radio or similar broadcast receivers, complete with Aerial, R.F. and Oscillator coils. Very compact unit, requires no tuning gang. Circuit of receiver supplied.

Full price delivered	£2 16 0
I.F. Transformers to suit type 919, per pair	18 2
Low voltage transformer, 240V primary; 4V; 2A Secondary, C.T. Type 103A	22 10
Type 103-6 Volt Vibrator Transformers	22 10

SEND CHEQUE OR MONEY ORDER, OR INSPECT AT FACTORY

FERRIS BROS. PTY. LTD.

752 PITTWATER ROAD, BROOKVALE, N.S.W. Telephone: XF 0221

NOTE:
ALL PRICES INCLUDE POSTAGE OR FREIGHT AND SALES TAX. NO EXTRA TO PAY.

1,500 miles are ideally situated. Accurately timed schedules are required and they normally last between one and five hours, with operating periods from 30 seconds to five minutes each. They are arranged to take place at favourable times during one of the annual meteor showers.

SSB Growing

EVERYONE is well aware that SSB is growing in popularity and extensive use of this mode of transmission is being made by amateurs throughout the world. A survey carried out by the ARRL amongst some 3,000 amateur radio club members revealed 11 per cent or 342 of them were using SSB. Another 91 were contemplating its use in the near future. It is estimated that the use of SSB on the HF bands ran nearly as high as 50 per cent of the phone stations operating. Activity is certainly high on 14 mc/s.

SSB nets for amateur traffic handling in the U.S. are becoming popular. Special SSB "fast" nets have been set up in emergency areas. Using full break-in procedure, it is generally conceded that they can handle more traffic in a given time than CW nets operating under similar conditions. W4IYT, a 40 w.p.m. CW traffic operator, supports this contention.

A special SSB contest is being conducted by CQ magazine in January. The object is to work as many prefixes on SSB as possible. (VK1, VK2, W1, W2, etc., count as separate prefixes). The contest commences at 1500 GMT, Saturday, January 28 and concludes at 2100 GMT Sunday, January 29. Only 24 hours of operating are permitted. The six hours of non-operation must be consecutive. Only one contact with any one station is permitted.

The usual serial number must be exchanged, e.g. 59,001, 59,002 and so on.

Final score is obtained by multiplying the number of different stations contacted by the number of prefixes worked. A trophy to the highest scorer in the world will be awarded and certificates to the highest scorer in each Australian call area.

Logs must show all times in GMT and a separate sheet should list operator's name and address, equipment in use, number of stations contacted, prefixes worked and final score claimed.

Logs should be forwarded to "Sideband" Editors, 12 Elm St, Lynbrook, N.Y. by March 30, 1961.

W.I.A. Field Day.

The WIA's National Field Day will be held on Saturday February 11, and Sunday, February 12, and the rules will be unchanged from those recorded for the 1960 contest. Support for last year's event was excellent and it is hoped more amateurs will journey into the field to enter the 1961 contest.

The BERU contest for 1961 will not be conducted until the week-end of March 11 and 12. For many years now the contest has been run in January. The change will suit Australian amateurs as in the past the contest has clashed on occasions with the VK National Field Day or with the many events such as conventions run over the Australia Day week-end. DX working is generally good between England and Australia around this period of the year.

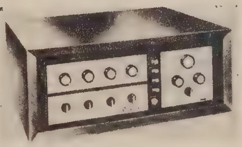
NOW YOU CAN HEAR...

"CITATION SOUND"

Frequency response 15c.p.s.—40 Kc at 60 watts!

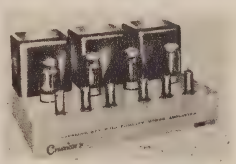
Never before in the history of Audio has so much unqualified praise been applied to equipment as to the Harman Kardon Citation series.

Designed without compromise, these amplifiers offer the best sound we have heard.



As illustrated — Citation I pre-amplifier, and Citation II power amplifier—complete in kit form ready for assembly —

£350



DO NOT think that Harman Kardon quality is only available at high prices.

The Lute: Model A220 amplifier offers twin 10 watt channels, input from magnetic or crystal pickups and superb styling at **ONLY £95.**

ALSO AVAILABLE:

The Ballad, twin 15 watt power amplifier **£125.**

The Aria, stereo FM/AM Tuner **£110.**

The Stereo Recital, complete FM/AM Tuner—stereo amplifier. Two stereo tuners, twin 12 watt amplifier channels, fully comprehensive input facilities: **£235.**

Write today for full details of this and ALL Audio equipment.

ARROW ELECTRONICS
PTY. LTD.

A member of the AE Group.

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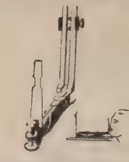
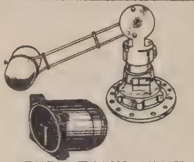


INCLINOMETERS

Will measure angles. Ideal for builders, farmers, etc., for elevation, depression, drainage etc.

£7/10/- Each

Post, N.S.W., 7/; Int., 9/6.

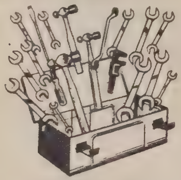


FUEL TANK UNIT AND GAUGE

Contains sender and receiver units. Used in place of Selsens as direction indicators.

15/- Pair

Post, N.S.W., 3/; Int., 6/.



SUPPLY RECTIFIER UNIT No. 13. NEW

INPUT. A.C.V. 240, 230, 220, 210, 200v. Also 100, 110, 120, 130v. OUTPUT D.C.V. 24v D.C. Tapped to give 2at 12v D.C., 3 amps output. Voltage output can be increased in small steps to 28v D.C.

£12/10/- each

Freight payable at nearest Attended Railway Station.

NATIONAL TRANSFORMERS

For Scope soldering irons, new. 240V A.C. in 3.3V out at 30 amps.

38/6 each

Post, N.S.W., 7/; Int., 11/.

LENSES AND PRISMS

4¼-inch concave reflecting mirror. 12/6.

Eyepiece, low power, 1¼in F.L., £3 ea.

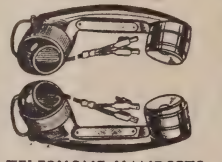
Eyepiece, high power, 5/8in F.L., £4/10/ ea.

Right-angle Prism, 2¼in square face . . . £4/10/-

Small Erecting Prism . . . . £1 ea.

Large Erecting Prism . . . . 25/ ea.

Add Postage.



TELEPHONE HANDSETS

NEW SOUND POWERED

No battery required. Ideal television installation intercom., field telephones, etc.

55/- ea.

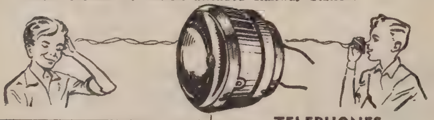
or £5 a pr. Post 5/-, Int. 7/6.

SPECIAL QUALITY TOOL OFFER

1 Set 6 SAE Set Spanners, sizes ¼in to 1in.
1 Set 6 WHIT. Set Spanners — 1/8in to 9/16in.
1 Ring Spanner, ⅝in x 11/16in.
1 Open-end Ring Spanner. 11/16 x 13/16.
1 Ring Spanner, 11/16 x 13/16.
1 Tube Spanner, 14mm x 18mm.
1 6in Shifting Spanner.
3 BALL PEIN Hammers — 8oz, 16oz, 24oz.
1 pair 6in PLIERS.
1 15ft tow-rope with spliced loop and steel hook.
1 METAL TOOLBOX, 19in x 8in x 7in.

THE LOT FOR £6/15/6

3/- Cartage to Rail.
Freight payable at nearest attended Railway Station.



VOLTMETER

0 to 15 volt DC and 0 to 220 volt DC, with probes. In waterproofed Canvas Case.

33/6 each

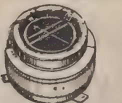
Post: 3/; Int., 4/.

OIL PRESSURE GAUGES

New. Suit cars, trucks, boats, stationary motors, etc. 0-150lb per sq. in.

£1 each

Complete with tubing.
Post: 2/6; Int., 3/.



P8 COMPASS

Liquid filled. As new. Ex-R.A.A.F. Ideal for small boats, etc.

£3/19/6 each

Post: 7/; Int., 9/6.

TELEPHONES

Sound powered, can be used as microphone or receiver. New.

38/6 Pair

Post, N.S.W., 2/6; Int., 4/.

A.W.A. COMMUNICATIONS RECEIVER

Type 2C8388. No. 24. Plug-in coils. 5 to 11 Mcs. with power supply and speaker.

£19/10/-

AIR SPEED INDICATORS

NEW.

8/6

Post: N.S.W., 2/6; Int., 3/.

PERISCOPES

10in x 4in x 1¼in. Contain two front silvered mirrors, 3½in x 1¼in x 1/8in.

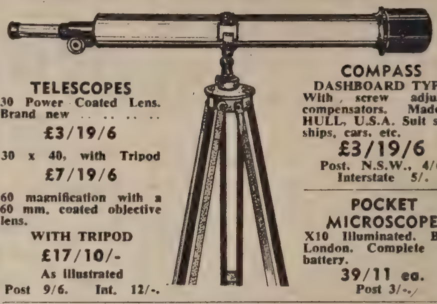
12/6 each

Post: N.S.W. 3/; Int., 4/-.

MANIFOLD PRESSURE or VACUUM GAUGE

29/6 ea.

NEW.
Post: N.S.W., 2/6; Int., 3/.



TELESCOPES

30 Power Coated Lens. Brand new . . . . . .

£3/19/6

30 x 40, with Tripod

£7/19/6

60 magnification with a 60 mm. coated objective lens.

WITH TRIPOD

£17/10/-

As illustrated

Post 9/6. Int. 12/-.

COMPASS

DASHBOARD TYPE.
With screw adjusting compensators. Made by HULL, U.S.A. Suit small ships, cars, etc.

£3/19/6

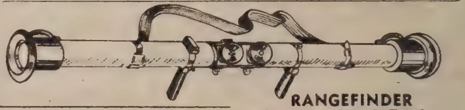
Post. N.S.W., 4/6; Interstate 5/.

POCKET MICROSCOPE

X10 Illuminated. Beck. London. Complete with battery.

39/11 ea.

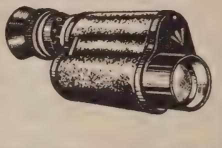
Post 3/-.



RANGEFINDER

Barr and Stroud Tubular Type. 4 ft length MK. V.

£12/10/-



PRISMATIC MONOCULAR

8 x 30. Ideal for Races, Football or General Viewing. This is the Monocular that is used as a telephoto camera lens. With Leather Carrying Case **£5/19/6**

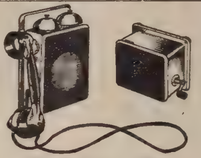
Post 4/6. Int. 6/-.

FIBRE PULLEYS (AMERICAN)

BALL BEARING.

1 3/8in diam., ¼in shaft, 30/ doz.
1¾in diam., ¼in shaft, 42/ doz.
2 3/8in diam., 3/8in shaft, 54/ doz.
3½in diam., 3/8in shaft, 66/ doz.

Add postage.



TELEPHONE SETS

Ex. P.M.G. Wall-type. Complete with Magneto Box. Battery operated. Ideal long distances.

£4/15/- each or £9 pair

Freight payable at nearest attended Railway station.

Dashboard COMPASS

Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

£9/17/6

CHASSIS

RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

45/- each

WIRE STRAINERS

Ideal for fencing, aerial cables, etc. Suitable for wire up to 5/16in dia. 37/6 per set.
Post N.S.W., 7/. Interstate 9/6.

TRANSFORMER AND RECTIFIER UNIT

New U.S.A. 240 A.C. 110-115V. Unit operates at 110v-115v D.C. at approximately ½ amp. out. from 240 V.A.C. in.
ALSO HAS A STEPDOWN TRANSFORMER 240 V.A.C. 100-115 V.A.C. AT 5.33 AMPS.

The unit has three outlets for A.C., two outlets for D.C., and will operate all voltages input around 240 V.A.C. and 110 V.A.C. has many input tappings, also has 110V rectifier choke and two 500 M.S.D. capacitors. Stepdown transformer 240V to 110V A.C. £10 or

Complete Unit £12/10/

Freight payable at nearest attended Railway Station.

COMPLETE TRANSMITTER NO. 153

A.W.A. type J51050 comprising R.F. unit, power control and minor rectifier unit and main rectifier unit, with spares. 100 watt R.T. 300 watt C.W. Crystal controlled 2 to 20 megs. with power supply. 110 or 240 volt A.C. 50 cycle. New. Will transmit over 500-mile range daytime. World range night. Original cost £2,000. Heavy-duty wide band aerial included.

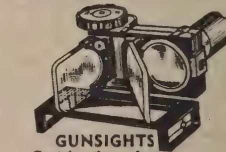
£125 COMPLETE

SECOND HAND £75 each

TELESCOPIC SIGHT

Ideal Rifle or Dumpy Level Sight.

47/6 Post, N.S.W., 3/; Int., 4/.



GUNSIGHTS

Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11/16in Focus, 1¼in dia.
1 Air Spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule.
1 Lampholder.

18/6 each Post: N.S.W., 2/6; Int., 3/.

DEITCH BROS.

70 OXFORD STREET, SYDNEY Between Crown and Riley Streets, City.

ON SHORTWAVE — By ART CUSHEN

The announcement of the construction of six 250,000 watt transmitters for the Voice of America, to be located in Liberia, has been made by the manufacturers, General Electric.

THE installation in Liberia, outside the capital Monrovia, is being made by the Voice of America to replace the present Tangier stations of 50 and 100Kw., which will be closing shortly. The new West African station will relay the programs of the Voice of America in Washington to Africa, and also act as relay with a secondary coverage in most areas throughout the world. This plan is similar to the new installations which General Electric are also building near Greenville, North Carolina. This facility for the United States Information Agency will centralise most of the East Coast stations of the VOA.

These super power radio stations are the largest ever built by General Electric International in its 40 years of operations. The Monrovia installations will serve as a relay for round the world broadcasts and the installations will include the latest electronic devices.

FREQUENCY CHANGES

Rapid change of frequency, vital to VOA operations, will be an outstanding feature of the new transmitters. High quality reproduction and low operating costs are features of the construction, and special emphasis is being placed on techniques to increase the intelligibility of the signals. The transmitters will use vaportron cooling, a French invention, in which the waste heat is carried away by steam, which is then condensed. In this method, which is simpler than others, no blowers or pumps are required, and the amount of water needed to cool a transmitter valve is decreased by 40 times.

These new transmitters are now under construction, and, with the new East Coast of the United States stations, listeners in future should find signals from West Africa and North America even easier to tune, and much more reliable than at present.

KGEI using 15225 Kc

A CHANGE in frequency has been made by the San Francisco station KGEI, which has moved from 17795 to 15225 Kc. for its service to Latin America. The station uses the slogan "The Voice of Friendship" and carries commercial programs in English, Spanish and Portuguese. KGEI has been on the air over some 20 years, first with the General Electric Company, then with the Voice of America, then under private control, and last report was that it had been sold to the Far East Broadcasting Company, Manila, with the idea of beaming programs of gospel broadcasts to the Far East. The present KGEI transmissions are heard with English on the air from 9.00 to 10.00 a.m., Spanish from 10.00 a.m. to 12.45 p.m. and 12.45 to 1.15 p.m. in English.

DX programs

GERMANY made a frequency change in its service to West Africa from 3.15 to 6.15 a.m. They are now using 11715 Kc. instead of 11870 Kc. The Cologne station is heard with good signals in the service to Australia and New Zealand from 4.45 to 7.45 p.m., and on the second Monday of each month at 6 p.m. the DX bulletin is broadcast, this being given in German and English.

RADIO JAPAN'S DX hour is now on the air on the third and fifth Saturday of each month, and is on the following schedule. 4.00 to 4.05 p.m. on 17825, 15235, 11800 and 6080 Kc. to Hawaii. To Europe from 6.00 to 6.10 p.m. on 21610, 17795 and 11705 Kc. To Australia from 8.10 p.m. on 15235 and 11725 Kc. To the Philippines and Indonesia, broadcast at 10.15 p.m. on 17795, 15135 and 11780 Kc. South East Asia is served from 1.15 a.m. on 11705 and 9675 Kc. To Near East, 4.25 a.m. on 11880, 9525 and 6080 Kc. and from 11.15 a.m. on Sunday to North America on 17855, 15135, 11780 Kc.

SWISS DX session is heard on Fridays from 6.45 p.m., and is also noted at 7.30 p.m. in a repeat broadcast. The station is heard on 11865, 17785 and 21520 Kc.

AUSTRALIA DX session from Melbourne is noted in several transmissions, from 8.00 a.m. on 15240 Kc., at 3.30 p.m. on 21680 Kc., and at 6.45 p.m. on 11710 Kc.

NEW ZEALAND has a monthly program "This Radio Age," which is now broadcast on the first Wednesday of each month, at 4.40 p.m. and at 8.30 p.m. using 9540 and 6080 Kc.

BRITISH Broadcasting Corporation's new weekly session, "Short Wave Listeners' Corner," which deals with items of interest to listeners, is on the air on Wednesday at 10.15 p.m., using 25840, 21550, 21470 Kc.

Changes for Cologne

SUMMER schedules now in effect from stations in Europe have resulted in many frequency changes, and the Deutche Welle broadcasts from Cologne can now be heard as follows.

The transmissions, which have been altered, are as follows: 7.45 to 10.45 p.m., to Japan, 17815, 15295 Kc; 3.15 to 6.15 a.m., to Africa, 15275, 11870 Kc; 5.15 to 7.51 a.m, to W Africa, 11925, 9505 Kc; 11.45 p.m. to 1.15 a.m., to M. East, 17815, 15275 Kc.

Austria on 6130 Kc

THE new 50 Kw transmitter of the Austrian Radio at Vienna has been noted on a new frequency of 6130 Kc at 5 p.m. The station still announces 6155 Kc as its only 49m frequency.

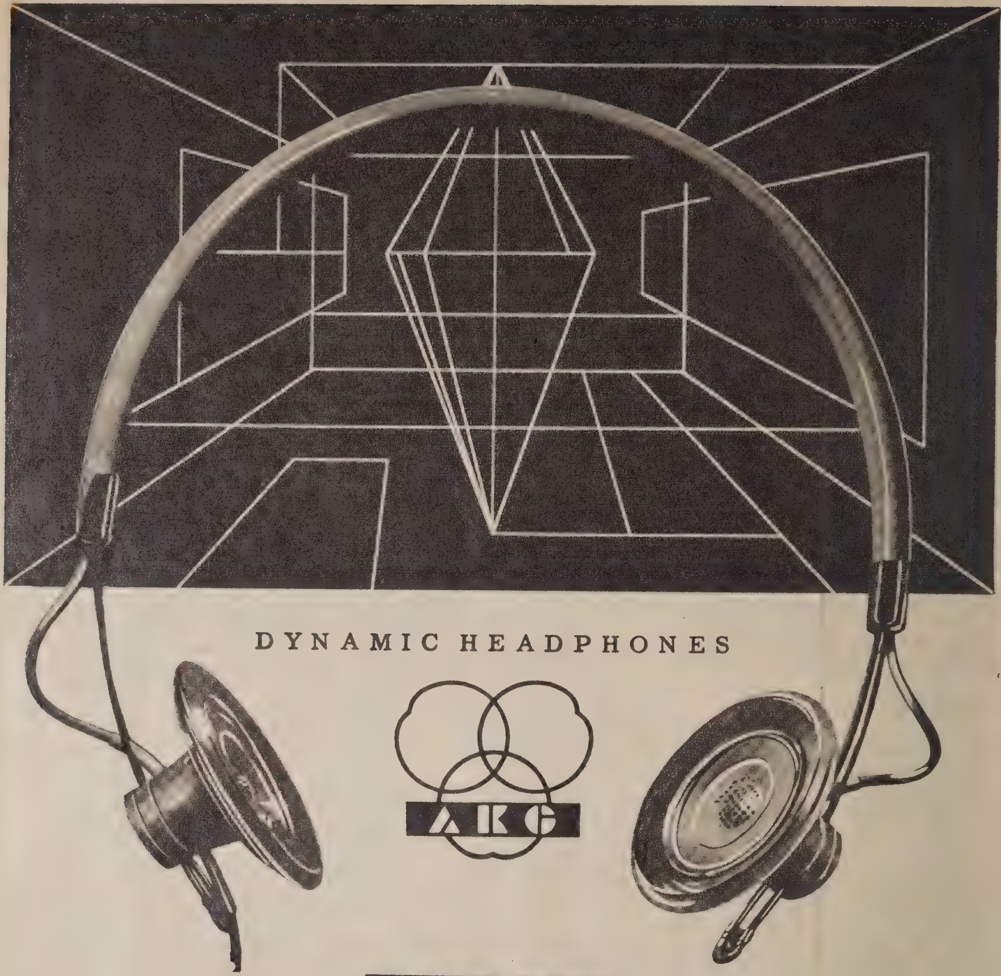
A NEW SCHEDULE FROM ATHENS

THE Greek short wave service with its broadcasts from Athens has announced substantial schedule changes and these are as follows:

5.00 to 6.15 p.m.	Cyprus	11720, 9605 Kc.
7.00 to 8.00 p.m.	Europe	11720, 9605 Kc.
8.30 to 11.00 p.m.	Cyprus	11720, 9605 Kc.
11.30 p.m. to 1.15 a.m.	Turkey	7296, 6075 Kc.
1.30 to 1.45 a.m.	U.S.S.R.	9605 Kc.
2.00 to 3.00 a.m.	Near East	11720, 9605 Kc.
4.15 to 4.45 a.m.	Cyprus	9605, 6075 Kc.
5.00 to 6.00 a.m.	North West Europe	9605, 6075 Kc.
8.00 to 8.30 a.m.	Near East	11720, 9605 Kc.
9.00 to 9.30 a.m.	To Near East	9605, 6075 Kc.

Caribe on 15050 Kc

A NEW experimental frequency is being used by Radio Caribe in Ciudad Trujillo, Dominican Republic, which is giving excellent reception in this part of the world. The station is using 15050 Kc in the afternoons and has been heard from soon after noon to fade out at 4 p.m. The station has more commercial announcements than in the past, and on Monday, when closing at 2.40 p.m. gives only the two old established frequencies of HI2U 6120 Kc, and H13U on 9485 Kc. The transmissions are on 50 Kw, and the station is used mainly for political broadcasts from Ciudad Trujillo. Signals on the 9485 Kc are better at 5 p.m., and this frequency we understand is on the air for 24 hours each day. Verification has been received from the station, which lists six medium wave and the two short wave calls and frequencies, and we presume the 15050 Kc frequency could be used in replacing 6120 Kc, which has not been very successful in its coverage due to interference from other stations.



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AKG

K 50

K50 Headphones utilize a new patented principle of sound transmission which, independent of a close fit of headphone to ear, gives true reproduction of all frequencies between 30 c/s to 20,000 c/s. Designed for monitoring stereo and mono programme material they are made to the standard that has made A.K.G. products world famous for quality and precision.

K50's are used for true sound monitoring in broadcasting, television, motion picture and recording studios in many parts of the world

FEATURES:

Frequency response: 30 c/s to 20,000 c/s.

Audible output: 95 phons with 0.150 mW per system (250 mV).

Harmonic distortion: Less than 1% total from 30 c/s to 20,000 c/s at 106 phons (1 mW per system or 630 mV).

Max. continuous output over entire range: 127 phons with less than 3% total harmonic distortion at 6 volts per system.

Impedance: 400 ohms per system.

Weight including 6 ft. cable: approx. 4 oz.

Australian Representatives:

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SABC using 11935 Kc

A NEW frequency has been taken over by the South African Broadcasting Corporation in Johannesburg for its Africa Service, a daily transmission which is on the air from 9 p.m. to 6 a.m. with relays of the home programs. On Tuesday, Thursday and Saturday the transmissions are in English and on other days in Afrikaans. The new service is now scheduled as follows, 9.00 p.m. to 3.00 a.m. on 21495 Kc, 9.00 p.m to 6.00 am. on 15265 Kc, 3.00 to 6.00 a.m. on 17855 Kc, 4.00 to 6.00 a.m. on 11935 Kc.

Service to Africa

TRANSMISSIONS from Radio D.D.R. in Berlin, broadcasting from the East German sector of the city, already have been noted in a new transmission for listeners in Africa. Information we have received from the station gives the present schedule as follows, English from 2.15 to 3.00 p.m., on 12008 Kc. French from 3.00 to 3.45 p.m. on the same frequency. The other English broadcasts from Berlin are on the air at 4.00, 6.00 and 8.00 a.m., when using 9730, 7300 and 6115 Kc.

Peking using 5030 Kc

RADIO PEKING has been noted using 5030 Kc with news in English at 3.00 a.m. This is one of the recently assigned frequencies, and it gives very strong signals in New Zealand. The station only announces as transmissions in the 19 and 31 metre band, but these two outlets are much weaker than the new 5030 Kc channel.

FLASHES FROM EVERYWHERE

FINLAND is now using a new frequency for its foreign service, and has been noted on 11960 Kc. which is used with 15190 and 17800 Kc. The Home program is now heard from 2.30 to 4.00 p.m. and from 1.00 a.m. to after 8 a.m., when using 6120 Kc.

ANKARA Turkey is providing strong signals with its English session at 7.00 a.m., the complete transmission being beamed to Western Europe from 5.15 a.m. German programs take the session to 5.45 a.m., then follows Italian, French at 6.15 a.m., Turkish at 6.45 a.m. and English at 7.00 a.m. The station uses 7285 Kc. for this complete transmission.

COLOMBO in Ceylon with the Commercial Service, carried in both Hindi and Tamil has extended its service from 10.30 a.m. through to 2.45 a.m. A frequency change has been made, and is now heard opening at 10.30 a.m. on 15375 Kc. instead of the former 15120 Kc.

SOUTH AFRICA is widely reported on 21525 Kc. with relays of their home programs. The station is being heard from midnight to 6.00 a.m. and on Wednesday, Friday and Sunday morning the transmission is in English, on other mornings it is in Afrikaans. The station has been heard with news in English at 2.00 and 5.00 a.m.

JAPAN commercial short wave station JOZ is to increase in power to 50 Kw. later this year. The NSB stations, Japan's only commercially operated short wave service, use 3925, 6055 and 9595 Kc. (in the past rated at 10 Kw.) and provide good reception in the evenings.

SANNAH with broadcasts from Yemen, has made an extension to its broadcasting hours and the transmissions are now on the air from 2.45 to 4.05 a.m. using 5985 Kc.

ETHIOPIA which we reported with test broadcasts from Radio Addis Ababa, has made some frequency changes in the continuation of the test series of broadcasts. The schedule to Europe is now from 4.20 to 4.40 a.m. using 11955 Kc. and to West Africa on 17775 Kc.

TUNISIA with broadcasts over Radio Tunis, in its external coverage, is using the following new schedule; 2.30 to 9.00 p.m. on 17795 Kc., 9.00 p.m. to 4.00 a.m. on 17705 Kc., 4.00 a.m. to 7.15 a.m. on 11970 Kc., 7.15 a.m. to 7.45 a.m. on 5985 Kc., with programs for the "Voice of Algeria," and 7.45 to 9.00 a.m. on 11970 Kc. The medium wave signal often heard at dawn in this area has moved from 629 to 647 Kc. with Arabic programs.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Time.

VIETNAM in broadcasts on VTVM is using a new frequency for its relay of local programs, and a Japanese listener reports the frequency as 9725 Kc. with the broadcast times from 6.00 p.m. to 1.00 a.m. and programs in Vietnamese. The station also uses 11960, 7239, 6165 and 4810 Kc.

LIBERIAN station ELBC, which uses 3255 Kc. for commercial programs has been noted in Europe. ELBC located in Monrovia has been in operation for several years, and on 3255 Kc. is reported to be relaying the B.B.C. news on weekdays at 5.00 p.m., 2.00 and 6.00 a.m. and Sundays at 7.15 p.m. 11.00 p.m., 4.00 a.m. and 6.00 a.m.

TAIPEH Taiwan has been using two new frequencies in its South Pacific service, but neither has been very successful. The program from 8.05 to 8.50 p.m. is heard on 6095, 15235 and 17785 Kc. Interference from Sydney VLI6 on 6090 Kc. causes trouble to the 6095 Kc. Taiwan frequency while Radio Japan uses the 15235 Kc. channel to 8.30 p.m., after which a clear signal is possible.

SOUTH KOREAN station HLK5 using 9640 Kc. now comes on the air at 8.15 p.m. with a program in Korean, and at 9.00 p.m. is heard with the broadcasts in English. Radio HLK5 at 9.30 p.m. is heard again in Korean. The Home programs of the Korean Broadcasting System are now heard on 7190 and 6035 with fair signals at 9 p.m.

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ANSWERS TO CORRESPONDENTS

R.L. (Haberfield, N.S.W.) sends us a sample of his Silver Brazing—a fine instrument bit for a "Scope" soldering iron. He also sends this tip which may revive a number of old 2.5 volt power transformers: Where the transformer has a 5-volt winding as well as a centre-tapped 2.5 volt winding, half the 2.5-volt winding can be put in series with the 5-volt winding to produce 6.25 volts, near enough to 6.3 volts. He adds that an indirectly heated rectifier must obviously be used, and to be careful regarding winding polarity.

A.: Thank you both for the iron tip and for the transformer "kink," R.L., also for your mention of your successes with audio equipment.

L.S.T. (Stanmore, N.S.W.) asks in reference to the Service Oscillator of September, 1960, whether the coils could be left in the original IF transformer cans allowing two coils to be in each can.

A.: Although this would certainly result in a compact arrangement, L.S.T., we feel, as you suggest, that considerable trouble would be experienced with coupling between the coils. This would result in random "dips" and variations in the oscillator activity, and would also hamper calibration of each band, since moving one slug would alter the inductance of the other coil.

S.H. (Auburn) sent us recently a very interesting letter, telling us of his experiences in the radio field. He also expressed his sympathy at the passing of our Editor, Mr Moyle, and sent us his wishes for a successful future for the magazine.

A.: Thanks for the letter, S.H., which we read with interest and appreciation.

S.D.S. (Pascoe Vale, Vic.) suggests we follow from the "Tape Recorder No. 4" circuit with a design built around the latest "Collaro" Studio Transcription tape deck.

A. We have already provided a circuit which is suitable in part for this deck, with the "Tape Recorder No. 3." This was in the issue before the smaller unit, namely June, 1960. This amplifier was designed to be suitable for a wide range of available decks, and this would include the Collaro deck.

G.L. (Col. Light Gardens, S.A.) sends us a number of transistor circuits for possible inclusion in the "Reader Built It" section of the magazine at a later date. He also asks, as a matter of interest, when "Radio and Hobbies" began. In reference to the "4 Transistor Superhet" of May, 1959, he feels that the inclusion of an IF stage rather than a detector stage would have improved the performance.

A.: Thank you for the circuits, G.L., which we will probably use in the appropriate section of the magazine. As for the date of the first issue of "Radio and Hobbies," it was in April, 1939. It took the place of a weekly publication called "Wireless Weekly," which had been running since August 4, 1922.

We used a frequency-conversion stage in the "4 Transistor Superhet" because it allowed us to make the following stage a regenerative detector having fixed regeneration. Thus we obtain superhet gain and selectivity without regeneration crankiness or "fiddling."

B.R.G. (Neutral Bay, N.S.W.) asks, in reference to the 25-watt amplifier of November, 1958, whether he could use 807 valves in place of the 6L6 valves specified. Also, could the filter choke be omitted, and do we intend describing a tremolo unit for guitar amplifiers.

A.: Yes, B.R.G., the 807 valves can be used in this circuit, with no changes other than the sockets.

For an amplifier of this type, we would recommend the use of the filter choke, as specified. However, a resistance-capacity filter could be tried similar to that used in the 17-watt Playmaster of September, 1958. Another way is to run the ouput plates directly from the rectifier output and merely use a resistance-capacity filter for the preceding stages. However, we have never tried this in a circuit of this kind.

Regarding the tremolo unit, we must repeat that we are keeping the idea in mind, but as yet we have no definite plans.

M.C.G. (Coburg, Vic.) queries our recent reference to the ARTS and P label attached to radio and television receivers.

A.: We won't attempt to answer you here MCG, but have dealt with your letter in our quoted arguments, as you probably anticipated we would.

J.R. (Town undecipherable, Vic.) asks how to connect a crystal earpiece to the "One Transistor Set for Beginners."

A.: Crystal earpieces have a high impedance, and, further, may be damaged if DC voltages are applied to them. Also, the one transistor set was designed for a load of from 2,000 to 8,000 ohms. To satisfy all the requirements, we suggest you try putting the primary or high impedance winding of a spare speaker transformer, or power choke in the circuit where the phones normally go. The crystal earpiece then can be fed by the voltage appearing across this winding, by connecting it, in series with a capacitor of about 0.1 mfd. across the winding. The earpiece then receives the AC signal voltage developed by the transformer or choke, but the capacitor blocks the DC present in the transistor circuit from the earpiece.

J. B. (Westburn, Vic.) says that he has spent some time of late listening to distant stations in daylight. He wonders whether there is any special interest in this activity at the present time.

A.: There used to be a great deal of interest some years ago in broadcast band DX, but we hear very little of it nowadays. We are publishing your name and address in case any reader who sees this may be able to correspond with you on the subject. (Mr John Baker, Westburn, Vic.).

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

To assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

G. H. J. (Managatang, Vic.) states that he built up the "Battery SW Converter" of February 1958, but used different coil formers to those described. He finds that the frequency band covered is not the same as that stated, stations only appearing on half the scale. He asks what would be the cause of this effect, and also the meaning of the letters on the coil bases.

A.: Winding the coils on different formers from those specified will result in a different frequency coverage, G. H. J., unless the correct adjustment is made to the wire diameter and turns. Due to lack of time, we are unable to work out the correct figures for your particular formers, but suggest you try to obtain formers similar to those specified, or consult a textbook for calculating the correct figures.

The figures G. A.. E and E on an aerial coil mean grid, aerial and both earth connections respectively. The markings G, B, P and F on an oscillator-coil mean oscillator grid, high tension (B-plus or HT), oscillator plate, and filament (which usually goes to earth via a capacitor).

F. J. (Perth, W.A.) asks if we will explain the difference between filter, smoothing and audio chokes.

A.: Well, F. J., they are all inductors and, as such, are used to act as a high impedance to AC. The filter or smoothing variety of chokes are used in power supplies to filter out the AC ripple from the rectifier circuit, passing on pure DC to the rest of the circuit.

Audio chokes, on the other hand, are used as loads for valves operated as choke-coupled amplifiers. Their high reactance coupled with low DC resistance enables high signal voltage to be developed. However, this type of amplification is not used much nowadays, either resistance-coupled or transformer-coupled amplifiers being used.

R., TV & H. VALVE TESTER

(Continued from Page 63)

400 scale if S6 is in the Beta x 2 position.

Diode testing is carried out by connecting the diode to the correct terminals and S8 to the FOR and then to the REV position. The ratio of the two readings is the ratio of the front-to-back resistance of the diode and, as such, gives a very good indication of its quality.

As stressed last month, the results obtained from both the valve tester and the transistor tester may often belie the results actually obtained in practice and the performance under actual operating conditions must often be the final criterion in deciding whether a valve or transistor should or should not be replaced.

Be that as it may, the construction of such an instrument is well worth the time and effort spent and will pay for itself over and over again in eliminating, to a large degree, the wasted time taken up with locating obscure and often hard to trace valve and transistor troubles.

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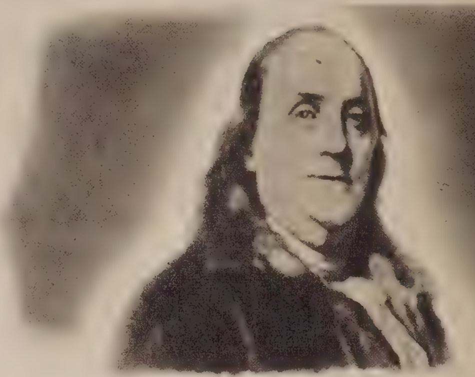

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The Dust-bug with its accurately shaped points of nylon bristle sweeps the groove in advance of the stylus and the foreign matter removed is trapped and collected on a plush pad, which discharges all static at the moment of playing. Skilful counter-balancing of the device ensures tracking performance is maintained. Records and styli are simultaneously protected from the rasping effect of the stylus point grinding dust into the groove. Expensive records are preserved — reproduction is improved.

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HOW OUR CHEMICALS ARE MADE

(Continued from Page 15)

the positive poles of the circuit are immersed in the solution. The cathode or negative terminal of the circuit is mercury which flows along the bottom of the tank at a slow speed.

When the current is switched on, it decomposes the sodium chloride into the metal sodium and the gas chlorine. The chlorine is set free at the graphite rods and is drawn from the top of the tank. The sodium is dissolved in the mercury.

Sodium, however, is a metal which reacts violently with water. It does so here with the production of hydrogen and caustic soda. The sodium is thus removed from the mercury which passes through the cell again to continue the process.

WATER EVAPORATED

If solid caustic soda is required, the water is merely evaporated by heat and the solid caustic soda crystallises out.

An interesting sidelight of the electrolytic process is that the two gases chlorine and hydrogen can be combined so that hydrogen chloride is formed. This is the well known hydrochloric acid or spirits of salts. When the hydrogen chloride is dissolved in water, in which it is very soluble, pure hydrochloric acid is obtained.

Pure hydrogen and oxygen can also be obtained by an electrolytic process where a positive and a negative electrode are immersed in a solution of caustic soda. Hydrogen is given from the negative or cathode and oxygen at the positive or anode. This process is being used more and more for the industrial production of these gases.

One of the most important elements in agricultural use is phosphorus, which is used in some form or other as a salt of the metal.

Everyone has heard of "superphosphate" but very few have any idea as to just what it is.

When you buy a bag of the evil smelling stuff called blood and bone or just bone meal, you are really buying a compound of phosphorus. Ground bones contain calcium phosphate which is a salt containing calcium and phosphoric acid.

TREATED WITH ACID

This was all that was used up to about the year 1851, when it was discovered that if the bones were treated with sulphuric acid, the calcium phosphate was converted into acid calcium phosphate and at the same time gypsum was formed.

Gypsum is a form of calcium sulphate which is also a valuable product for the conditioning of soil. The name given to this mixture of acid calcium phosphate and gypsum was "superphosphate"

Not all superphosphate, however, is made in this way. In certain countries there are great deposits of what is called phosphate rock from which most of the world's supply of superphosphate is now made.

Another fertiliser called triple superphosphate is made by treating calcium phosphate with phosphoric acid. This fertiliser contains about three times the amount of phosphoric acid, hence the name. So much then for fertilisers. We will now take a brief glance at the now very well known detergents which supersede soap to a great extent.

The main object of soap and detergents is to make water wetter. Water on its own has a high surface tension. That is, the molecules of the outside surface stick together so closely that a "skin" is formed, so to speak, which makes it difficult for water to spread evenly over surfaces.

By reducing this surface tension of water, soap and detergents allow the water to flow more evenly over dirty or greasy surfaces. In addition soap has an emulsifying power so that, once it comes in contact with grease or oil, it emulsifies it and thus removes it from the surface to which it is adhering.

The use of detergents other than soap gained impetus during the last war in Germany where the shortage of fats resulted, in turn, in a shortage of soap.

WETTING AGENT

It was found that certain substances called ethylenes treated with sulphuric acid and combined with sodium to make a sodium salt, gave compounds which were greatly superior to soap as a wetting agent. They had the added advantage that they did not combine with magnesia and calcium to form insoluble compounds. They were thus valuable for use with hard water and did not form the well known scum around the bath.

The explanation of the formation of this scum is rather interesting and perhaps worth a little detail.

We all know what hard water is. Soap won't lather in it no matter how hard you try and it is useless for washing greasy dishes unless it is "softened" in some way.

When the acid of fats and oils are combined with sodium and potassium, they form salts which are soluble in water. These are the salts formed in ordinary soap made with caustic soda or caustic potash. The salts of calcium (lime) and magnesia are not soluble in water and these are the two chemicals which make water "hard."

If attempts are made to use soap in such hard water the soap decomposes and forms salts of calcium and magnesium which are separated from the water and forms the scum we know so well.

NO LATHER

Because the soap is decomposed, as described, it follows that no lather can be obtained. It is possible to get a lather in time but as sufficient soap must be used to separate out all the calcium and magnesium salts in the water, it follows that the process is very wasteful of soap.

Like the story of two sailors scrubbing the deck of the ship. One said "Where's the soap?" and the other said "Yes." Get it?" "wears the soap" HA HA!

This separating of the two salts of calcium and magnesium from hard water is responsible for the scale in boilers. After a time the salts attach themselves to the sides of the boiler tubes with great loss of heating efficiency.

Softening of water is carried out by many processes, including one which has now found favour. By heating quartz, alumina and sodium carbonate together with subsequent crushing, a product is obtained which removes the calcium and magnesium from water which passes through the compound. This is a chemical action which renders the filtering compond useless after a while. It can be recovered however by washing with common salt.

PURIFYING WATER

An important advance in purification of water was made during the last war. Certain types of synthetic resins were found to be able to separate calcium, magnesium and sodium from water. By passing the water through one resin, only free acid remained in the water.

By passing this water through the other resin the acid was removed, leaving only carbon dioxide in the water. This was removed by passing air through the water which was finally rendered very pure and fit for human consumption.

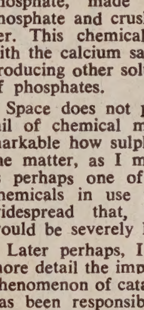
It was such a process on a miniature scale in the form of kits which enabled wrecked sailors and airman to purify ocean water during the war.

Of late there is a widely advertised product on the market which added to hard water renders it "soft."

This is a chemical called by the formidable name of sodium hexametaphosphate, made by heating sodium phosphate and crushing into a fine powder. This chemical acts by combining with the calcium salts in hard water and producing other soluble salts in the form of phosphates.

Space does not permit of further detail of chemical manufacture. It is remarkable how sulphuric acid enters into the matter, as I mentioned earlier, and is perhaps one of the most important chemicals in use today. Its use is so widespread that, without it, industry would be severely handicapped.

Later perhaps, I hope to describe in more detail the important and fascinating phenomenon of catalysis, a process which has been responsible for an astounding expansion of various industries.



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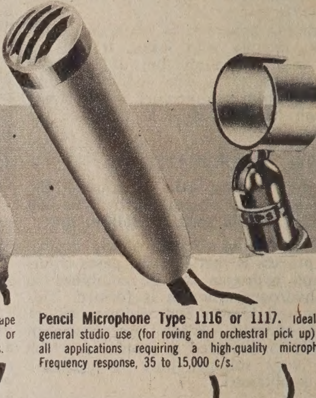
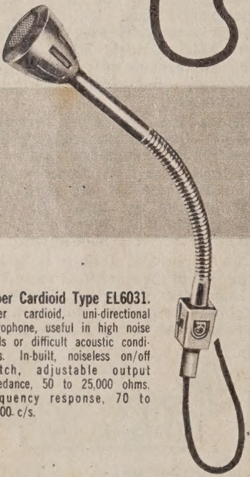
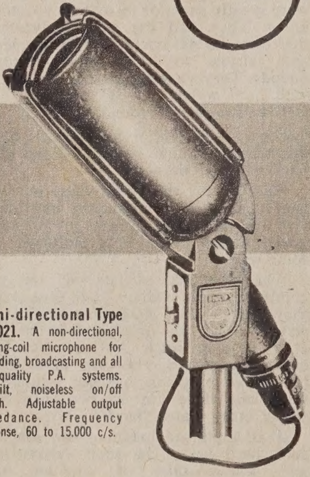


Pencil Microphone Type 1116 or 1117. Ideal for general studio use (for roving and orchestral pick up) and all applications requiring a high-quality microphone. Frequency response, 35 to 15,000 c/s.



Hyper Cardioid Type EL6031. Hyper cardioid, uni-directional microphone, useful in high noise levels or difficult acoustic conditions. In-built, noiseless on/off switch, adjustable output impedance, 50 to 25,000 ohms. Frequency response, 70 to 15,000 c/s.



Omni-directional Type EL6021. A non-directional, moving-coil microphone for recording, broadcasting and all high-quality P.A. systems. In-built, noiseless on/off switch. Adjustable output impedance. Frequency response, 60 to 15,000 c/s.

Moving Coil "Pencil" Type EL6040. For highest quality broadcasting and stage work. In-built, noiseless on/off switch and adjustable output impedance, 50, 500, 25,000 ohms. Frequency response, 35 to 15,000 c/s.

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TRANSISTORS— HOW THEY OPERATE

(Continued from Page 73)

collector resistor is present the collector voltage remains at ground potential. The base-emitter bias will usually be reversed from normal, causing a very weak or dead radio. Again, the larger the emitter and collector resistor, the greater will be the change in voltages. If no resistor is present in the collector circuit, for example, there will be no change in collector voltage unless the transformer has appreciable resistance.

The following points should be kept in mind when conducting voltage checks:

1. Watch for proper relationship between base, emitter and collector.
2. A far from normal base voltage usually means that there is trouble in the base circuit.
3. An open emitter circuit causes a loss of forward bias between emitter and base; and an open collector circuit puts emitter and collector at the same voltage.
4. A leaky transistor will cause a higher than normal collector current and may reduce or reverse the forward bias.

ELECTROMYOGRAPHY AND MUSCLE ACTIVITY

(Continued from Page 23)

calibration circuit is also built into the system.

A valuable addition is a separate audio power amplifier of standard hi-fi quality which allows the low-frequency impulses to be heard through a loudspeaker. This is possible because all the muscle impulses fall within the lower end of the audio spectrum.

The different sounds produced by the various waveforms are very useful to the examiner because each is characteristic of a particular condition. After some experience with the electromyograph, an individual can recognise an abnormal condition by sound alone. Some muscle impulses produce sounds like static noise in a radio, others like a diving aircraft, still others like machine-gun fire or a diesel locomotive or the chugging of an old model-T Ford.

THE SERVICEMAN WHO TELLS

(Continued from Page 45)

in part, to the disinterested neglect with which this simple service has been performed in the past.

Many of us resent the wholesale testing of valves for customers. We feel it is a waste of time, both his and ours, for we know from past experience that indiscriminate valve testing is often a most inefficient way to locate trouble.

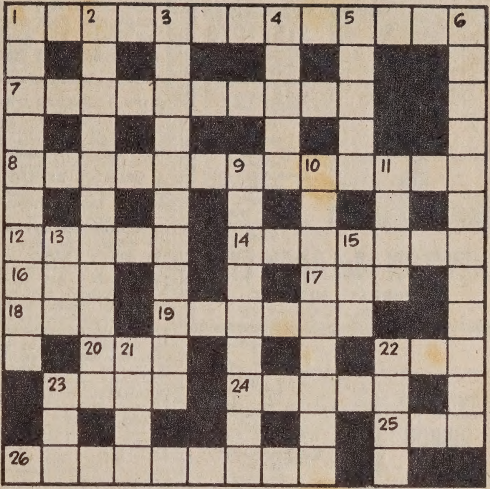
This feeling shows in our attitude, and the customer is made to feel that he is imposing on us. A number of servicemen even make a small charge for this "service."

We would do well to look to the attitude taken by the filling stations. For many years they have been multiplying and thriving while offering a whole list of free commodities and services: free air; free water; free checks of radiator, battery, and oil level; free windshield cleaning, etc.

All these services consume time, and some of them, such as purchasing and maintaining an air compressor, represent a considerable outlay of money; yet most service stations cheerfully provide this service. Obviously it pays to do so. And it will pay us to check valves cheerfully without charge, too, no matter what anyone says to the contrary.

Valves are still among the most profitable items a serviceman sells, and still more important is the contact that testing valves provides with the customer. If no faulty valves are found, almost invariably we get the service job. At the very least we will have moved a step in the direction of good customer relations.

THE R., TV & H. CROSSWORD No. 81



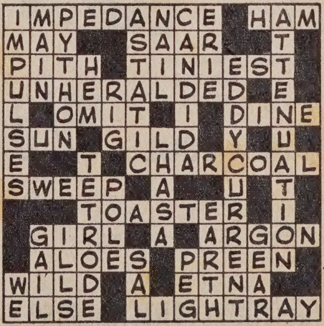
ACROSS

1. It flows in only one direction.
7. The production of electrical effects.
8. Small inductance coil connected to an indicator of current flow.
12. It usually follows treasure.
14. Tricky.
16. Fabulous bird.
17. Possibly.
18. Girl's name.
19. Raid.
20. Meadow.
22. The male of the swan.
23. Serpents.
24. Angry.
25. Have position.
26. Old buildings.

DOWN

1. The term for any non-conducting medium.
2. What figures, when multiplied together, always give one as the answer?
3. System of bias.
4. Connection.
5. Scandinavian.
6. Three insulated conductors twisted together.
9. Invasion.
10. Secondary radio-active rays.
11. Well lubricated.
13. Slender stick.
15. Fill out.
21. Fencing term.
22. Part of a battery.
23. Card.

Last month's solution



I	M	P	E	D	A	N	C	E	■	H	A	M
M	A	Y	■	■	S	A	A	R	■	■	T	■
P	I	T	H	■	T	I	N	I	E	S	T	■
U	N	H	E	R	A	L	D	E	D	■	E	■
L	■	O	M	I	T	■	I	■	D	I	N	E
S	U	N	■	G	I	L	D	■	Y	■	U	■
E	■	■	T	■	C	H	A	R	C	O	A	L
S	W	E	E	P	■	A	■	■	U	■	T	■
■	■	■	T	O	A	S	T	E	R	■	I	■
■	G	I	R	L	■	A	■	A	R	G	O	N
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